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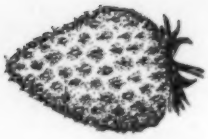

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The Association's Program

AT THE Executive Committee meeting in Bloomington, Indiana, June 30–July 1, critical attention was focused on the broad connotations of the Association's program of activity. Its diversity is evident enough, as a summary of the more important items of business will indicate:

Pursuant to the vote of the Council, which approved creation of an Alaska Division 198 to 1, the Committee authorized the establishment of a Southeastern Branch at Juneau; appropriated funds to enable the Division to carry on regular business and to organize the Second Alaskan Science Conference; and instructed Kirtley Mather to act with Governor Gruening at official installation ceremonies at the opening of the conference September 4 in Mount McKinley National Park.

Since the Council had also voted 191 to 7 to establish a Section P on Industrial Science, the Executive Committee appointed N. V. Hendricks, of Esso Laboratories, to serve as secretary, Allen D. Brandt, of Bethlehem Steel Company, to act as 1951 chairman, and Paul E. Klopsteg to function as committeeman until the new section is organized. Detlev W. Bronk was chosen to install Section P at the Annual Meeting in Philadelphia next December.

Association meetings received their share of attention. Drs. Mather and Meyerhoff reported on those of the Southwestern Division at El Paso and the Pacific Division at Los Angeles. Symposia for the Philadelphia convention were discussed, and prospects and problems of the St. Louis (1952) and Boston (1953) meetings were previewed.

The Association's publications were considered at length. Members of the Editorial Board were reappointed, but it was agreed to add a few editorial consultants, whose principal function will be to assist in the diversification of the content of SCIENCE. The continued rapid increase in the circulation of THE SCIENTIFIC MONTHLY was noted, as was the popularity of the two recent symposium volumes—*Brucellosis* and *The Pituitary-Adrenal Function*. In considering four new proposals for special volumes, the Executive Committee affirmed that the Association will not compete in book publishing with commercial concerns but will limit itself to books important to scientists.

Among other matters examined were the Association's modest support of research, its cooperative activities with other organizations, its relations with 223 affiliated and associated societies, its Gordon Research Conferences, and its support of the work sponsored by the Cooperative Committee on the Teaching of Science and Mathematics.

Despite the ramifications of a program involving meetings, publication, and service to science and scientists in this country and abroad, the committee welcomed a recommendation of three members that there be a "total analysis of the work of the AAAS" to determine "what must be done to advance science from the point at which it stands in June 1951." Without a dissenting vote or adverse argument the committee agreed to assess the entire program of activity in a three-day session immediately preceding the regular meeting in mid-September. A few of the Association's "best friends and severest critics" will be invited to sit with the full Executive Committee for the purpose of reviewing current activities and appraising them as an organizational program in keeping with the requirements of the times.

It is not assumed that anything is organically wrong. The proposed survey is analogous to a medical check-up whereby the patient may learn that he is in excellent health, and that he can maintain or improve this state by simple, salutary measures. No one has illusions about the possibility of improvement in the Association's program, and there is no question but what activities can be greatly expanded. Whatever is planned must be within the Association's modest financial means, but the Executive Committee wants the best it can provide for science within the means at its disposal.

HOWARD A. MEYERHOFF
Administrative Secretary

SCIENCE, founded in 1880, is published each Friday by the American Association for the Advancement of Science at the Business Press, 10 McGovern Ave., Lancaster, Pa. Entered as second-class matter at the Post Office at Lancaster, Pa., January 13, 1948, under the Act of March 3, 1879. Acceptance for mailing at the special rate postage provided for in the Act of February 28, 1925, embodied in Paragraph (d-2) Section 34.40 P. L. & R. of 1948.

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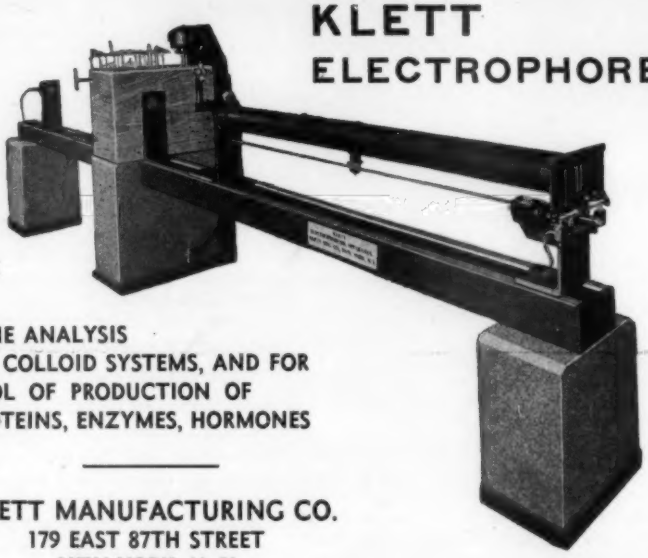

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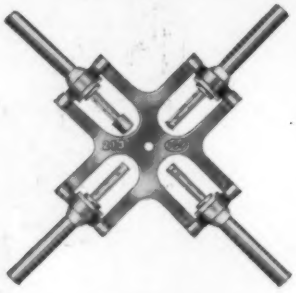

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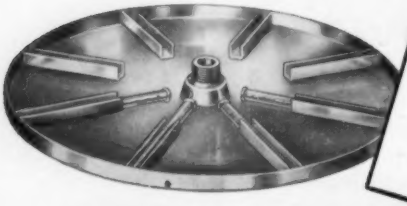

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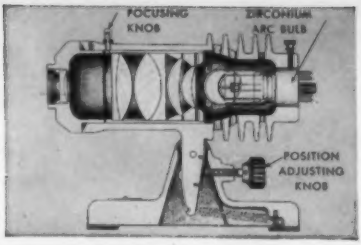

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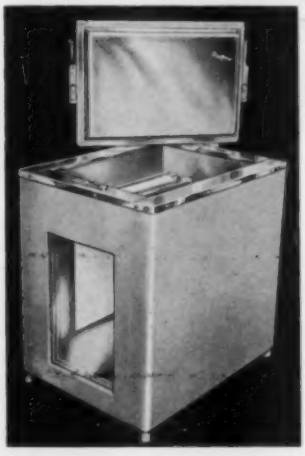

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A New Approach To High Resolution Radioautography[1]

R. M. Fink

Department of Investigative Medicine,
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and *Department of Physiological Chemistry, Medical School,*
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THE OFT-REPEATED STATEMENT that a radioactive tissue slice will "take its own picture" when placed against a photographic emulsion is true only to a rather limited extent. When there are large differences in radioactivity among various gross structural or functional portions of a tissue, a radioautograph may indeed bear a close similarity to a macrophotographs of the stained tissue section, and such radioautographs have provided information concerning distribution of radioisotopes in very much greater detail and quantity than it would have been feasible to obtain, for example, by microdissection and measurements with a Geiger counter.

If ordinary radioautographs are magnified beyond 5 or 10 diameters in an attempt to examine the radioisotope distribution on a microscopic scale, however, it is found that the magnified radioautographs no longer resemble "pictures" in the usual sense of the word, but appear more like groups of hazy smudges or irregularly distributed silver grains, which reproduce little, if any, of the microscopic structure of the tissue source, and frequently yield little more information than that provided by gross inspection of the original radioautographs. The primary difficulty, of course, lies in the fact that the particles emitted by radioactive atoms show a random distribution as regards their direction of travel. Since, in order to affect a photographic emulsion, the particles must be able to penetrate tissue and emulsion to a significant extent, a radioautograph of a single point source of radioactivity resting on the surface of a photographic emulsion would consist of a group of silver grains distributed within a circular area around (or with a thick emulsion, in a hemisphere under) the point source. The apparent diameter of the circle would depend principally upon the penetrating power of the emitted particles and the intensity of the exposure. The amount of exposure is involved because a minimum concentration of silver grains (or a minimum percentage increase in concentration over that due to background "fog") is required before the emulsion shows a detectable darkening, and the geometry of the system is such that this concentration of grains should be reached first near the source (the geometry being somewhat similar to that in wheels, where the "concentration" of spokes decreases from the hub to the periphery). In the case of most biologically important radioisotopes, which emit β-particles with a spectral distribution of energies, the effect of exposure intensity is made still more important by the fact that particles of all energies emitted can react in the small area immediately around the source, whereas the production of a significant concentration of grains in the much larger area near the maximum range of the particles is especially slow because it depends on the relatively small proportion of highly energetic particles emitted. The diameter of the significantly darkened circle about a point source of radioactivity is usually the limiting factor in the resolving power of the radioautograph, since if a second point source were placed less than this distance from the first, the two "circles of confusion" would overlap and fail to show clearly the double nature of the source.

A variety of approaches to the problem of increasing the resolving power of radioautographs has been reported or suggested. About the only type of approach that has been both moderately effective and generally applicable to biological studies (*1, 2*) involves placing a thin tissue section in intimate contact with a thin emulsion and leaving the tissue and emulsion fastened together for microscopic examination. Use of the thin source and emulsion increases the relative importance of the less penetrating particles and reduces the probability that the more energetic particles will be in the emulsion as they near the end of their paths. Leaving the tissue attached to the emulsion eliminates the need for cross-comparison or realignment of tissue and radioautograph and thus facilitates the use of low exposures by making it unnecessary for the radioautograph to "picture" any histological structures. By examining the combination under high magnification, with only the tissue and the immediately adjacent portion of the emulsion in the plane of focus, one may obtain the effect of an exceedingly thin emulsion. The availability of special β-particle emulsions that have small grain size, high stopping power, and very low background fog (*3*) has still further increased the amount of information that may be extracted from lightly exposed radioautographs with the tissue section still attached. This

[1] Reviewed in the Veterans Administration and published with the approval of the chief medical director. The statements and conclusions published by the author are the result of his own study and do not necessarily reflect the opinion or policy of the Veterans Administration.

simultaneous observation of tissue and radioautograph makes interpretation so convenient that the technique will probably continue to be used for routine studies, even though techniques giving much higher resolution but lacking the simultaneous observation feature become generally available.

With intensely radioactive specimens, it might conceivably be possible to collimate the emitted particles by absorbing the unwanted ones before they reach the emulsion. If a sheet of solid material thick enough to absorb all but a small fraction of the incident particles were placed between an emulsion and a tissue containing an α-particle emitter, a fairly high resolution might be achieved, since the absorber would pass only those α-particles approaching the surface of the emulsion at an approximately perpendicular angle. For β-particles, which are easily deflected and show a wide range of penetrating power, however, the solid absorber would have to be replaced with one resembling a microscopic or submicroscopic honeycomb, the openings of which could pass "well-aimed" β-particles into a very thin emulsion while most of the "poorly aimed" particles were being deflected and absorbed by the walls. It is at least conceivable that such a microhoneycomb exists or could be prepared, but there is some question as to how advantageous its use would be.

Probably the highest degree of radioautographic resolution possible has been obtained with α-particle emitters (*4, 5*). Using special α-track emulsions under high magnification, the path of an α-particle may be traced back to the point at which it entered the emulsion. Under ideal conditions, with an exceedingly thin tissue section in perfect contact with the emulsion, the source of the particle might be estimated with an error of less than a micron. Although it has recently become possible, under suitable conditions, to produce visible β-particle tracks in an emulsion, the tortuous paths of these light particles would make their tracing much more difficult and their extrapolation into the tissue section very much less accurate than in the case of α-particles (*6*).

Any procedure that overcomes the problem posed by the random direction of the emitted particles to such an extent that it is capable of showing the source of nuclear particles on a truly microscopic scale is likely to become involved with a secondary limitation on the useful resolution achievable with a radioautograph: the number of radioactive atoms that can be packed into any given microscopic or submicroscopic structure is severely limited (especially under physiological conditions), and their emission of nuclear particles is random with respect to time. For this reason it will probably never be possible to obtain highly enlarged radioautographs showing the clarity and structural detail of pictures taken through light or electron microscopes, with their practically unlimited source of neatly collimated photons or electrons. If this secondary limitation (in the number of particles available) becomes of major importance, it may be found that the information locked in the radioautograph can be extracted only by an exhausting statistical approach (correlating the data from a large number of similar structures in order to estimate the relative concentration of radioisotope in that type of structure). It can be seen, for example, that if a radioautograph showed only three particles issuing from a given cell, and indicated that all three particles came from one vacuole, the finding might be interesting but would, by itself, have little statistical or biological significance, for a second radioautograph (if sufficient activity remained) might very well show several particles from other parts of the same cell and none from that particular portion. If the primary problem of the random direction of the particles is minimized by wasting a large proportion of the energy emitted from the tissue, the limited supply of particles may become a serious factor even at rather low degrees of resolution and require a statistical approach or result in a radioautograph too light to be detected in the background "fog."

The collimation of particles by absorption of unwanted ones would certainly involve tremendous wastage of the available energy, and the use of limited exposures of thin, fine-grain emulsions in order to minimize the effect of the high-energy particles also fails, in a sense, to make full use of the radioactivity available. Even with the elegant α-track procedure one must limit exposure to a level which avoids a confusion of tracks over any given microscopic structure, and the technique for tracing α-tracks one at a time would usually necessitate a statistical approach for mapping the fine-scale distribution pattern of the α-emitters.

A uniform electrostatic field could pull the nuclear particles toward paths normal to the plane of the emulsion and thus might improve resolving power without entailing further wastage of energy, but the potential gradient that could be maintained without arcing would probably show little effect on the circles of confusion from most of the biologically important radioisotopes. A uniform magnetic field could cause the particles to follow spiral paths between collisions and thus might improve resolution to some extent by decreasing the average straight-line penetrating power of the particles.

The ideal solution would be a focusing arrangement that could cause all the particles emitted in any direction from a given point in the specimen to impinge on a corresponding point of an enlarged image on a photographic plate. Then the exposure could be as intense as the specimen could make it, and, because of the enlarged image, exceedingly fast large-grain emulsions could be used to lay down a maximum amount of silver for each unit of energy available. Marton and Abelson (*7*) reported the achievement of a 30-μ resolution using a very thin but highly radioactive layer of a monergic (internal conversion) β-particle emitter and a low-aperture magnetic lens at a magnification of 1.6 diameters, but a generally applicable procedure along these lines seems quite remote unless fundamental advances in electron optics produce a high-aperture electron lens corrected for

spherical and "chromatic" (variable energy) aberrations.

There remains an approach which theoretically would show many of the advantages of an excellent focusing arrangement and some additional ones: if the *tissue itself* could be *mechanically enlarged* before the radioautograph is made, as a picture on a balloon is enlarged when the balloon is inflated, the maximum diameter of the circle of confusion about each radioactive point source would remain the same as before, but each point in the tissue would be farther away from every other point; ergo, increased resolving power. This principle has occasionally been involved to some extent in radioautography under special conditions. For example, in one unpublished instance in Hamilton's laboratory a partial microdissection performed by the microtome during preparation of a bone section resulted in an unexpectedly clear demonstration of the presence of plutonium in the periosteal tissue.[2] Similarly, dilute blood smears on β-particle emulsions provided Boyd *et al.* (*8*) with beautiful radioautographs showing the presence of high concentrations of radiocarbon in some of the widely separated blood cells and its relative absence in others.

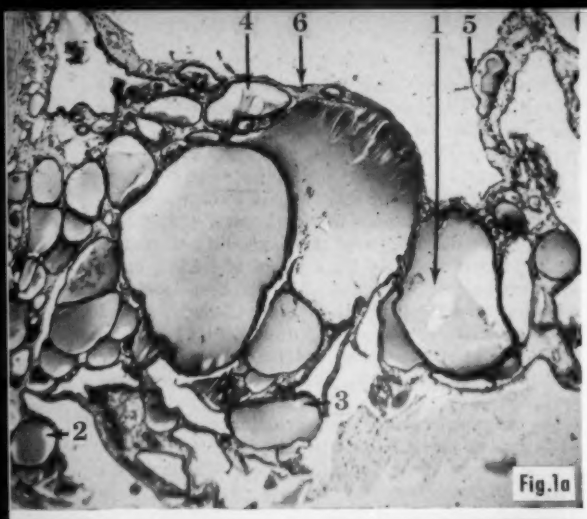
An early thought in connection with mechanical enlargement of tissue sections was that it might be possible to perform a microincineration of a tissue section containing a nonvolatile radioisotope, fuse the ash into the glass mount (or between two layers of glass), and then blow the glass into a very thin bubble. A microincinerated specimen, with its lack of cohesion between various portions of the ash, may yet prove to be the best type of preparation for tissue magnification, but the only radioactive tissues immediately available for testing were rat thyroids containing easily volatilized radioiodine. Mostly out of curiosity as to what might happen, a thin thyroid section was placed between two slightly flattened lead balls and the two balls were then squeezed in a small hydraulic press, on the theory that each part of the tissue would be tightly held by the pressure from the lead atoms above and below and that as the lead atoms began to flow outward the tissue might expand with the lead. When the two flattened disks of lead were peeled apart, the inner surface of each showed an area with a visibly different texture from the rest. The shape of this odd-textured area corresponded roughly to the shape of the thyroid section but was about twice as large as the original section. When a radioautograph of the inside surface of each disk showed a magnified outline of the gross histological structures of the thyroid section, with a clarity at least as good as that of the original radioautograph, a series of experiments was begun to test some of the possibilities of enlarging intact tissue sections. These experiments have not progressed to a point at which it is possible to outline a comprehensive set of optimum conditions for mechanical magnification of tissue sections or to predict the ultimate resolution achievable by the procedure, but the results obtained indicate that this type of technique may be of real value in biological radioactive tracer experiments. The work was greatly facilitated by the discovery that the tissue did not need to be between two equally thick pieces of lead in order to expand evenly. This meant that the tissue could be mounted on a relatively thick piece of lead, covered with lead foil or with a piece of lead that would be quite thin after expansion, and the radioautographic film finally exposed right through the thin lead covering.

An example of the improved resolution obtained in these preliminary studies is shown in Figs. 1 and 2. The tissues used were 7-μ sections of a nodular colloid goiter surgically removed from a patient six days after he had received 1.66 mc of I^{131} orally. A paraffin section from the formalin-fixed nodule was floated onto an albumin-coated microscope slide, dried, and tightly pressed against "No-screen" x-ray film for 4 hours to give an ordinary natural-size radioautograph, which was photographically enlarged 48 diameters (Fig. 1*b*). The section was then deparaffined, stained with hematoxylin and eosin, mounted in balsam, and a photomicrograph prepared (Fig. 1*a*). The next serial section was mounted, stained, and photographed in the same manner,[3] and is reproduced as Fig. 2*a*. The cover slip and balsam of the second slide were removed with xylene, and the slide was then placed for a few minutes each in amyl acetate, amyl acetate containing 1% pyroxylin (Parlodion, Mallinckrodt), and amyl acetate containing 5% pyroxylin. The thick pyroxylin film was allowed to harden in air, scratched in a long rectangle about the section, and then gradually floated or teased off in warm water, taking care to proceed slowly enough to allow time for the water to soften the albumin between the section and the slide.

The pyroxylin-embedded section was placed on the center of a 40-mm lead disk, 13 mm thick, and a drop of amyl acetate was used to flatten it and attach it to the disk. The lead disk was then placed in amyl acetate for 2 hours, after which it was gently removed and the excess amyl acetate and pyroxylin wiped from around the tissue section. As soon as the tissue appeared on the point of drying out, a lead foil about 0.1 mm thick and 4 mm square was carefully placed over it, and the disk, tissue, and covering foil were immediately subjected to 8 tons of pressure between

[2] Shown informally at a Manhattan Project Conference in 1945. (The author used, without specific acknowledgment, this and other bits of then-classified information concerning plutonium metabolism in calculations for his National Nuclear Energy Series volume, and is happy to be able now belatedly to acknowledge J. G. Hamilton, at Berkeley, and W. Langham, at Los Alamos, as the principal sources of that information.)

[3] The author is indebted to a number of members of the Long Beach Veterans Administration Hospital staff for their cooperation in this study, and in particular to M. E. Morton and the Radioisotope Unit for making available some radioactive human tissues obtained in the course of their diagnostic and therapeutic work, to B. E. Konwaler and the Laboratory Service for assistance in the preparation of special sections and slides, and to T. Masterson and the Medical Illustrations Laboratory for the photographic reproductions. The radioiodine was obtained from the Oak Ridge National Laboratory on allocation from the U. S. Atomic Energy Commission.



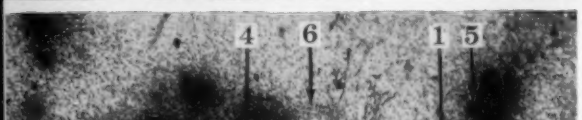


FIG. 1. *a*, Photomicrograph of 7-μ section from nodular colloid goiter surgically removed from patient six days after oral administration of 1.66 mc I^{131}. Formalin fixation, hematoxylin-eosin stain. ×48. *b*, Radioautograph prepared from above section before it was processed for photomicrography. "No-screen" x-ray film was pressed against paraffin section on albumin-coated slide for 4 hr, tank-developed 7 min at 68° C in Eastman x-ray developer. ×48.

polished and slightly oily steel platens. This pressure gave about a 30 per cent enlargement of disk, tissue, and foil, and firmly fused the three together. The disk was then trimmed to a smaller circle, keeping the still-visible foil near the center, and pressed again, giving a further expansion. The trimming and pressing were continued until the foil had been expanded about threefold; the disk was then trimmed to give a square slightly larger than the foil. This square of lead was gradually expanded, first in one direction and then in the other, in a small rolling mill (two polished steel rollers, 77 mm in diameter by 150 mm long, geared together, and turned by a hand crank in heavy brass bearings, which were set in an iron frame arranged to allow adjustment of the space between the rollers). As the lead square became too thin for convenient handling it was backed by a lead sheet cut to the same size, and the expansion and backing with lead sheets continued until the square was as wide as the rolling mill. A sheet of "No-screen" x-ray film was taped to the foil side of the square, and the film and lead were scratched to facilitate subsequent realignment, wrapped in black paper, and covered with a thick sheet of sponge rubber, a board, and a 100-mm layer of lead bricks. The film was developed after two weeks and showed that the tissue section had been mechanically enlarged approximately 20 diameters. This radioautograph of the expanded tissue was further enlarged photographically (Fig. 2*b*) to give a total enlargement roughly comparable to that of the ordinary radioautograph (Fig. 1*b*) and the photomicrographs (Figs. 1*a* and 2*a*). A casual inspection shows that the expanded tissue suffered some distortion (portion to right of arrow 1 expanded too much in horizontal direction, and portion around arrow 2 expanded too much toward lower left quadrant), but the major "landmarks" are shown with a clarity that permits fairly detailed comparison with the corresponding photomicrograph. Distortion is apparently most likely to arise from nonparallel surfaces of the platens in the hydraulic press, and from flexibility of the rolling-mill frame, which causes the edges of the lead square to expand more than the center. In addition to reproducing the major landmarks, Fig. 2*b* gives a fairly faithful rendering of many microscopic details that are more or less completely lost in Fig. 1*b* (e.g., breaks in the colloid indicated by arrows 3 and 4, a line of cells, possibly with shrunken colloid attached, arrow 5, and what appears to be a closely spaced group of microfollicles, arrow 6).

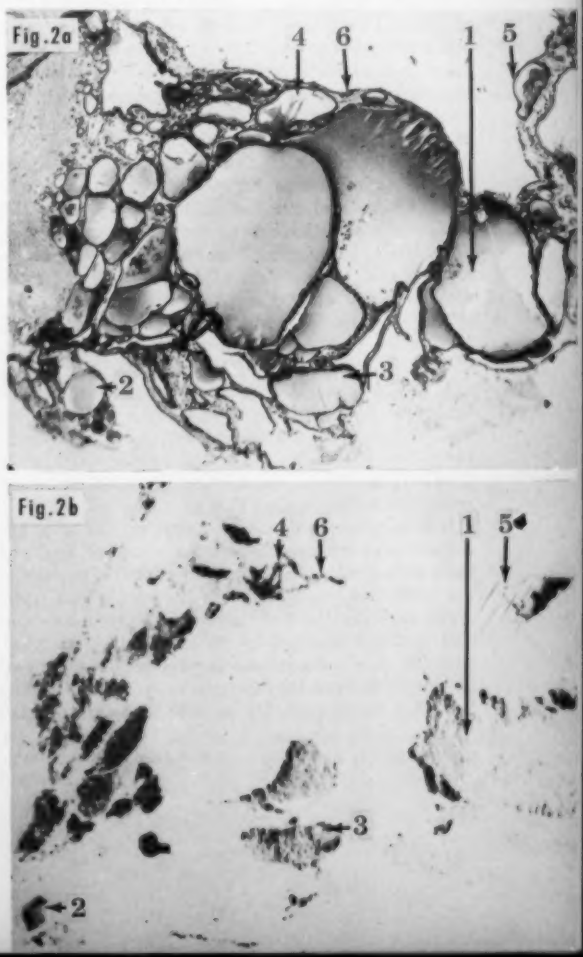
Some of the fine structure apparent in Fig. 2*b*, however, is probably an artifact. The radioactive colloid, for example, shows a markedly granular radioautograph. It seems probable that radioiodine is not distributed with exact uniformity throughout the colloid of any one follicle, for higher magnifications show the colloid to be filled with vacuoles of various sizes, and carefully prepared thin, tissue-thin-emulsion thyroid radioautographs occasionally appear to show a nonuniform distribution of radioiodine within a single follicle. Examination of radioautographs of tissues at various stages of enlargement and tests of expansion in lead of materials other than tissues (e.g., gold leaf) strongly indicate, however, that most of the granularity of the expanded colloid arises because the expanding lead fails to "stretch" the tissue out smoothly molecule by molecule, but rather tears it into microscopic fragments and then carries these fragments apart while maintaining approximately their original orientation relative to their neighboring fragments. The resolution obtainable with any given type of tissue section and technique of mechanical enlargement will probably be limited by the size of these separated fragments. Measuring the distance between centers of

a large number of the visible points of radioactivity in the radioautograph reproduced as Fig. 2*b* (allowing for the degree of mechanical enlargement) indicates that the diameter of most of the fragments is about 10 μ. Some portions of the radioautograph show the presence of considerably larger fragments or may even indicate that large fragments have held together for part of the expansion and then started to break up. Other portions, however (e.g., arrow 1), indicate that the fragments are so small (and so closely spaced) that the resolving power of the radioautograph is insufficient to show them clearly as separate fragments at this relatively low degree of mechanical enlargement. High degrees of mechanical magnification (up to 100 diameters) of intensely radioactive sections[4] generally resulted in very spotty radioautographs because of fragmentation of the tissue, but even these frequently showed some areas in which the size of the tissue fragments was apparently not the limiting factor in the resolving power of the radioautograph. Some of the uniformly exposed areas were obviously due to poor contact between lead and film, but many have shown sharply defined edges of the radioactive area and give a basis for predicting that an improved mechanical magnification technique may eventually yield radioautographs with very high resolving power throughout (though it is hardly to be expected that expansion in lead will ever be made so smooth that cleavage of chemical bonds by "stretching" will become a common procedure). In the meantime, an easily obtainable resolution, such as that illustrated in Fig. 2*b*, may be sufficient to solve some difficult problems of isotope distribution, provided the interpretation is made with the realization that much of the apparent fine structure may be an artifact produced by fragmentation of the tissue.

A wide variety of techniques for expanding tissues in lead gave a fairly good resolution and reasonably low distortion. No procedure was developed whereby the resolution achieved could be determined accurately, but judging roughly from the granularity of the radioautographs of colloid follicles it appeared that some of the best results were obtained when the lead disk employed for the initial expansion in the hydraulic press was fairly thick and had no ratio of thickness to diameter such that application of 8 tons of pressure would increase the diameter by about 20–50 per cent. This apparently resulted in an optimum balance between the grasping and the expanding forces applied by the lead, and although the optimum conditions seemed not to be very critical, they might be expected to vary somewhat with the type of tissue and the physical condition of the section. Several grades of lead were tested without finding any that were distinctly superior, but it seems probable that further experimentation with very pure lead and with lead alloys might determine the most desirable qualities of materials to be used for tissue expansion and indicate whether the size of the tissue fragments is more dependent on the granularity of the lead or on the cohesive forces in the tissue itself.

A few experiments with a 200-ton hydraulic press indicated that the degree of expansion obtainable with a reasonable thickness of lead was quite limited as

FIG. 2. *a*, Photomicrograph of serial section adjoining that used for Fig. 1. ×48. *b*, Radioautograph prepared from same section after it was embedded in lead and mechanically enlarged (along with the lead) by pressing and rolling. Approximate enlargement: mechanical, ×20; photographic, ×2.4; total, ×48. The radioautograph was exposed for two weeks through a very thin (approx 0.2 μ) layer of lead covering the expanded tissue. Film and development as in Fig. 1 *b*. For explanation of arrows, see text.



[4] Figuring the amount of radioactivity required for a satisfactory radioautograph of an enlarged tissue is somewhat complicated. The increase in exposure required after enlargement would be proportional to the increase in the area of film covered by the tissue if the radioisotope were uniformly distributed in the tissue, if the enlargement were smooth (molecule by molecule), and if the original tissue section were large as compared to the penetrating power of the emitted particles. In practice, however, the isotope is generally concentrated in small areas and the enlargement involves fragmentation of the tissue, so the required exposure increases much less rapidly than the area of the tissue section. The advantages of the tissue enlargement technique are most pronounced with highly radioactive sections (for local overexposure does not interfere with the radioautograph of adjacent weakly radioactive areas), but a tissue with a level of radioactivity that is convenient for preparation of natural-size radioautographs on thin, fine-grain emulsions is likely to yield fairly satisfactory radioautographs on fast emulsions after moderate mechanical enlargement.

compared to that easily attained with a rolling mill. The resolution obtained with the large press[5] was not particularly good under the conditions employed, and even with hardened steel platens an inch thick, the edges of a six-inch lead disk were pressed thinner than the center, causing a considerable distortion of the embedded tissue. Some of the difficulties with this press might have been eliminated if highly polished platens had been available.

Some remarkable liberties may be taken with a heavy and accurately machined rolling mill. Using a silversmith's mill (after swearing to remove all bits of lead from the shop and taking an oath of secrecy concerning the one-time presence of such a base metal there), it was found possible to take a lead-embedded tissue section 3 mm in diameter, roll it out into an ellipse 3 mm × 250 mm, cut the long strip into three sections, and then, by subjecting each section of the strip to a second rolling at right angles to the first, to restore the tissue to approximately its original shape. The major internal structures of the tissue were still recognizable in a composite radioautograph, and the resolution appeared to be about as good as that achieved by the gradual expansion of a lead square in the light rolling mill constructed in the laboratory shop.

A few experiments, generally with inadequate techniques and equipment, have failed to turn up a suitable substitute for lead. Silver appears to be too hard (though it could be made to take an impression of a thyroid section), and it requires high-temperature annealing during the expansion process. The sample of presumably pure gold tested also appeared to be insufficiently malleable, and an attempt to use goldbeaters' techniques in expanding tissues, even with easily fusible lead, resulted in the jarring or blowing of fragments of tissue away from their proper positions. Use of a transparent material for the expansion would avoid the problem of transferring the tissue section intact after the photomicrograph was obtained, and would permit simultaneous microscopic observation of the tissue fragments and their radioautographs, at least during the early stages of expansion of the tissue. A number of low softening point thermoplastics tested appeared to show little promise, but the tests were not carried out under ideal conditions, and it is conceivable that among the host of plastic formulations and fabrication techniques available there might be some that would be suitable.

It is possible to expand a tissue section to a few diameters in lead, peel apart the pieces of lead and then, with a coat of collodion, to remove a portion of the tissue fragments sufficient to give a radioautograph showing the main structures. The number of lead particles removed by the collodion is so great, however, that microscopic inspection of the tissue fragments is essentially impossible, and some cleaner substance would probably have to be substituted for the lead as a first step in rendering this sort of technique useful. An attempt to adapt this lead expansion–collodion film procedure for preparation of thin sections for electron microscopy (*9*) also failed to show much promise. Of all the materials tested as possible substitutes for lead, the waxes appeared to show most nearly the properties required for tissue expansion. Placing tissue sections between thin disks of paraffin or beeswax and pressing out between cellophane-covered platens resulted in the formation of nearly transparent wax disks in which the tissue was pressed so thin or fragmented to such an extent that it was rather difficult to find fragments for study under the microscope. Radioautographs prepared from such wax disks, however, indicated very poor resolution, and the tendency to local streaming in the expanding wax was so great that the radioautographs rarely showed any recognizable similarity to the original shape and structure of the tissue section. It seems possible that the advantages of direct microscopic observation of the tissue fragments would be such that a relatively poor expansion technique employing a transparent medium, in which the tissue could be broken into recognizable fragments and the fragments separated a reasonable distance without being squeezed too thin for microscopic visibility, might prove of greater value than techniques achieving much higher resolution with an opaque expanding medium.

No systematic study has as yet been made of the resolution obtainable with tissues other than thyroid, or with various section thicknesses, fixation techniques, or procedures for rendering the tissue sections more frangible. Transferring a section to a lead disk and then heating to a point which browned the section but failed to volatilize the radioiodine or melt the lead resulted in decreased resolution, probably because of oxidation and irregular hardening of the lead surface. Heating after the tissue had been pressed between two pieces of lead resulted in the formation of gas bubbles between the layers of lead and loss of resolution. In one test of nonthyroid tissues a droplet of a pond water culture containing a variety of microscopic animals was placed on a lead disk, and a droplet of radioactive iodine-iodide stain was added. The droplet was removed slowly by a thin strip of filter paper, the former position of the droplet covered with lead foil, and the disk expanded. The radioautograph showed a high background of general radioactivity; because of the lack of a guiding photomicrograph interpretation was uncertain, but there were a number of intensely darkened areas visible to the naked eye, which appeared to correspond to the shape of some of the larger forms of protozoa present in the culture. A rotifer, which was easily picked out in the radioautograph by several observers, appeared to have been expanded in quite small fragments, though there was one noticeable break in the radioautograph of its extended flagellum. If it is possible to develop a suitable procedure for preparing, photographing, and expanding frozen sections, radioautography with short-lived radioisotopes would be facilitated, for it should be

[5] The author is indebted to E. H. King, Engineering Department, University of California at Los Angeles, for operating the big press for these experiments.

possible to expand frozen sections in lead and have them placed against a photographic plate within a few minutes after their removal from the animal. A technique for expanding frozen sections should also be very useful as a means for binding in place the volatile and diffusible radioactive substances ordinarily lost or displaced during tissue processing procedures.

On occasion it has been desirable to cut out a small portion of a lead square and the expanded tissue embedded in it in order that further expansion of the selected portion of tissue might be carried out more easily. With a tracing of the radioautograph as a guide such cutting can be done with a high degree of accuracy, and feats of microdissection which would originally have been exceedingly difficult may be reduced by the tissue expansion to a level of difficulty approximating that involved in the cutting out of paper dolls. Although radioautographic procedures have been used for some time to localize radioactive *elements* on a relatively fine scale, studies of the biochemical transformations which a radioactive element or compound undergoes have for the most part been limited to whole organs or macroscopic tissue structures. With experiments of the type in which the use of high concentrations of radioactivity is allowable, this simplified microdissection technique, combined with very sensitive analytical procedures such as paper chromatography of radioactive compounds (*10*), may aid in extending our knowledge of intermediary metabolism by facilitating a more accurate localization of the sites at which various biochemical processes take place.

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Technical Papers

The Influence of Skin Temperature upon the Pain Threshold as Evoked by Thermal Radiation[1]

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That reduced skin temperature can result in cutaneous analgesia is well known, and skin temperatures near 0° C cause local anesthesia (*1*). Also, Schumacher (*2*) and Graham, Goodell, and Wolff (*3*) have reported that vasodilation of the superficial vessels of the skin lowers the cutaneous pain threshold. However, a systematic investigation into the effect of the level of skin temperature upon the pain threshold for pricking pain evoked by thermal radiation has not been reported. To investigate this matter quantitatively the following experiments were performed.

The pain threshold on the blackened skin of the forehead and the back of the hand of 4 subjects was measured by the Hardy-Wolff-Goodell (*4*) method, in a room at 26° C. Skin temperatures were measured with a radiometer (*5*) prior to each test of pain threshold. The subjects then moved into a room at 8° C, and the skin temperature and pain thresholds on the forehead and back of the hand were measured at 5- to 10-min intervals over a period of 1 hr. The subjects returned to the room at 26° C, and the measurements were continued for 2 additional hr as the skin temperature returned to control levels.

The results of these observations are shown in Fig. 1 by the solid line drawn through the averaged readings plotted for the forehead and the hand. The same relationship of pain threshold to the level of skin temperature was observed for both areas. Cooling of the skin 10° C resulted in an elevation in pain threshold of roughly 200 millicalories/sec/cm².

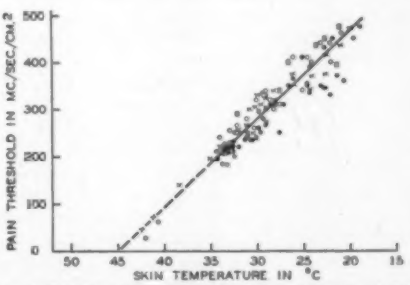

Fig. 1. Relationship between pricking pain threshold and skin temperature.

In a second experiment, the blackened skin of the forehead of 2 subjects was irradiated with intensities of thermal radiation which caused elevation of skin

[1] These studies were aided by a contract between the Office of Naval Research, Department of the Navy, and Cornell University Medical College (NR160-023).

temperature. During this heating there was no visible sweat on the forehead even though the skin temperature was maintained at levels between 38° C and 43° C. When a constant skin temperature had been attained, the warm skin was exposed for 3 sec to a second source of radiation, the intensity of which was adjusted to give a threshold pricking pain at the end of the exposure. The pain threshold was ascertained by measuring the intensity of the radiation incident upon the skin from the second source. Skin temperatures were measured with a bare wire thermocouple laid on the forehead after the method described by Stoll and Hardy (*6*). The dashed portion of the line in Fig. 1 is drawn through the averages of the results of this series of measurements. Heating the skin of the forehead 10° C caused a lowering of the pain threshold of approximately 200 mcal/sec/cm².

The fact that the relationship between levels of skin temperature and pain threshold is characterized by a straight line passing through zero stimulus at a skin temperature of 44.9° C suggests that the skin in the areas tested must be raised to this temperature to be noxiously stimulated, regardless of the initial level of skin temperature. Thus it is the actual skin temperature level that is critical as regards noxious stimulation of the skin, and not the rate of skin temperature rise nor the amount of skin temperature elevation (*4, 7*).

From these observations it follows that to obtain the most accurate measurement of pain threshold by the thermal radiation method it is necessary to correct for the temperature of the skin being tested. This can be done for the forehead and back of the hand from the curve in Fig. 1 or by the following formula:

$$\text{Pain threshold} = 220 + 20\ (34^\circ\text{ C} - T_s)\ \text{mcal/sec/cm}^2,$$

where T_s = skin temperature in °C at the time of observation.

Originally the forehead was the only skin area used for pain threshold tests because of the constancy of its skin temperature (34° C ± 0.5° C) under laboratory conditions. However, errors will be introduced into measurements of pain threshold even on the forehead if the room temperature is lower than 20° C. In warm rooms (30°–35° C) the forehead temperature will not increase greatly, but sweating will occur and thus interfere to some extent with the measurement of pain threshold. It is desirable to keep the laboratory temperature between 20° C and 30° C when making pain threshold measurements on the forehead. When other parts of the body are being studied their skin temperature should be ascertained and corrections applied to the pain threshold measurement. The average skin temperature on other parts of the body, in the comfort zone of environmental temperature, is roughly 33° C. It should not be inferred that the pain threshold on all parts of the body when corrected for skin temperature will be the same as that obtained on the forehead or the back of the hand. For example, it has been found that the pain threshold on the lips and on the lumbar region of the back ranges from 80 to 150 mcal/sec/cm², even with skin temperatures between 33° C and 34° C (*8*). This difference in pain threshold must be attributed to differences in skin thickness, sensitivity of nerve endings, or both.

Pain evoked by thermal radiation stands in contrast to the sensations of warmth and cold as regards the effects of altered skin temperature upon the threshold (Fig. 2). Warmth shows no change in

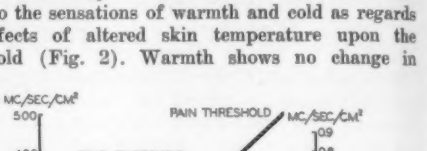

FIG. 2. Influence of skin temperature upon the thresholds of warmth, cold, and pain. Pain thresholds are referred to ordinate at left; warmth and cold thresholds, to ordinate at right of diagram.

threshold between skin temperatures of 27° C and 36° C, although there is an *elevation* in the cold threshold for an *increase* in skin temperature from 32° C to 34° C (*9*). From this it can be deduced that the effects of the thermal stimulus on the skin in producing noxious stimulation are entirely different from those evoking thermal sensation, and that the cutaneous receptive mechanism subserving pain is distinct from that for warmth and cold.

Buettner (*10*) and Henriques and Moritz (*11*) have shown that reversible tissue damage in the skin of the forearm and upper leg of humans is produced at the critical temperatures of 44° C to 45° C. In the above experiments threshold pain has been elicited when the skin temperature has been raised to roughly this same level, irrespective of the initial level of skin temperature. From these two independent observations the close relation between tissue damage and noxious stimulation can be inferred, thus significantly supporting the concept that the adequate stimulus for pain is tissue injury.

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Chylomicrons as Carriers for Carcinogenic Hydrocarbons

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Astonishingly little attention has been paid to the physicochemical state in which the water-insoluble carcinogenic hydrocarbons are transported in the body. Although we know comparatively little about the routes and under what conditions, as well as in which form the assumed extrinsic chemical carcinogens enter the living organism, it is—in the study of these problems—most advantageous that the circumstances are as normal as possible.

Observations made on the fate in the body of carcinogenic hydrocarbons applied intravenously as nonnatural (and unstable) suspensions are of little practical significance, or at least the results are difficult to interpret. It is very likely that the carcinogens in real life would not be transported in the form mentioned above. In spite of this, just these methods have, in general, been employed in the studies reported.

Because carcinogenic hydrocarbons are insoluble in water but soluble in fat and fat solvents, it is most likely that their metabolism, especially their absorption mechanism in the body, is linked to that of the lipids in general.

Alimentary fat is transported from the gastrointestinal tract mainly along two routes: to the portal veins and further to the liver, and through the lacteals and the thoracic duct in the general circulation. The physical state in which the main part of the absorbed water-insoluble lipids in the blood stream is transported is that of an extremely finely divided chylomicron emulsion, the average diameter of the particles varying from 0.5 to 1 μ (*1*). The chylomicrons are chiefly composed of neutral fat, the composition of which varies depending on the nature of the alimentary fat (*1–3*). Plasma globulins and albumins make the emulsion stable (*3*).

In our experiments we have observed large amounts of blue fluorescent material in the contents of the mesenteric lymphatics and in those of the thoracic duct in mice and cats after gastric instillation of 3:4-benzpyrene (*4*).

In addition, it has been possible for us to determine that this hydrocarbon or its blue fluorescent metabolites exist in the blood in association with chylomicrons after intestinal absorption of the hydrocarbon, dissolved in fats.

The animals used, about 50 in all, were adult mice of an anonymous known strain employed for several years in our experiments. The dark-field microscope was used; however, instead of the usual visible light, a Philora HPW 125-w mercury vapor lamp served as the light source. Various natural fats and unsaponified liquid petrolatum were used as carriers for the 0.5% hydrocarbon. The use of ultraviolet light considerably decreases the sensitivity of the method, and only a part of the blue fluorescent particles, in Brownian movement, can be distinguished. Because of this, the exact number of the fluorescent chylomicrons cannot be established with certainty with the technique employed in the present work. Therefore, control determinations using the usual dark-field illumination were carried out simultaneously.

After a moderately fatty meal in man, fat in particulate form appears in the blood about 1–1½ hours postprandially, and the maximum is reached in about 3 hr (*1, 2*). In the mouse the postprandial chylomicronemia is practically identical with that in man. Fig. 1 presents the average chylomicrograph in mice.

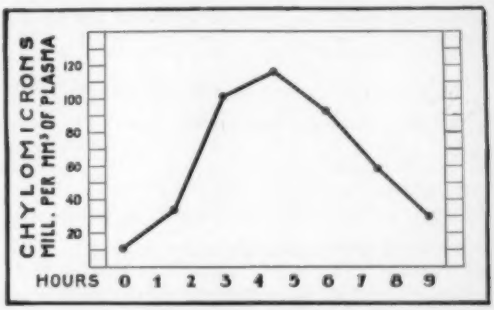

FIG. 1. Normal chylomicrograph in mice.

After a fasting period of about 12 hr 0.05 ml of arachidis oil, containing 0.5% of the hydrocarbon, was fed by means of a stomach tube. The number of the chylomicrons was estimated, using a special counting chamber, which allows quantitative determinations (*2*).

The observations made are not in disagreement with the results reported earlier in the literature when the distribution of hydrocarbons in the blood has been determined by chemical methods or by radioactivity (e.g., *5, 6*), though the results obtained in studies of the "natural" distribution and those reached when artificial, nonnatural suspensions are given intravenously are not per se comparable. The red cells did not contain visible blue fluorescence (*cf. 5*).

Alimentary lipids in the blood can also occur in solubilized state. To what extent and how this happens, has not been established with certainty. The plasma is, as is known, able to dissolve minimal amounts of hydrocarbons, and certain additional factors somewhat increase this solubility.

At all events, depending on their special character, the chylomicrons form a peculiar separate phase in the metabolism and transport of lipids. Under normal circumstances the chylomicrons of the blood are naturally not engulfed by phagocytes in the lung, for instance, as is the fact when nonnatural carcinogenic suspensions are employed: to the latter the organism

reacts as against foreign bodies. The distribution of the alimentary fat into the portal and the lymph system is influenced by several different factors. These have, however, not been sufficiently taken into account in the experimental chemical carcinogenesis with carcinogenic hydrocarbons.

Provided that some carcinogenic agents enter the organism in the diet together with lipids, and bearing in mind the physiologic background, it is possible that additional light may be thrown on the knowledge of the differences, e.g., in geographic and racial occurrence of certain tumors.

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A New Development in the Measurement of High Relative Humidities

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It is often desired to measure high relative humidities in remote and confined spaces. The problem that presents itself here is twofold: First, the sensitivity of most hygrometric instruments decreases rapidly as the relative humidity approaches 100%; second, most standard methods of hygrometry are not applicable to remote and confined spaces. Falling into one category or the other, or both, are such methods as the use of the hair hygrometer, psychrometer, dew-point hygrometer, or the chemical absorption and refractometric methods.

The possibility of overcoming the major difficulties may be found in the electric hygrometer. For obvious reasons an electrical instrument would be especially suitable for remote applications. There are a number of different types of electric hygrometers, all identical in principle: the relative humidity is measured as a function of the electrical conductivity of a hydrophilic chemical. F. W. Dunmore (*1*) has developed an electric hygrometer whose sensitive chemical is a combination of lithium chloride and polyvinyl acetate. The American Instrument Company (*2*) has on the market an instrument supposedly based on that of Dunmore. H. J. Kersten (*3*) has developed an electric hygrometer whose sensitive chemical is gelatin. All these instruments have in common the fact that they are rather small, the dimensions being of the order of a few centimeters. Thus they would be ideal for use in remote and confined spaces.

The sensitivity characteristics, however, vary considerably. It has been found that gelatin is unsatisfactory for the present purposes in that the sensitivity is very poor near 100% relative humidity. Inorganic hygroscopic salts alone are unsatisfactory in that they become wet at high humidities. The combination of an inorganic hygroscopic salt and a hydrophilic colloid, such as used by Dunmore, seems to be the best approach. In the present work lithium chloride and polyvinyl alcohol are used.

The sensitive element consists of a miniature coil form such as is used in radio work, wound with a bifilar winding of #38 AWG platinum wire. Each winding has a pitch of 2 mm, a total length of 3 cm and a diameter of 19 mm. It is important that an inert metal such as platinum or palladium be used for the wire. Metals such as copper or steel produce an aging effect whereby the resistance changes with time.

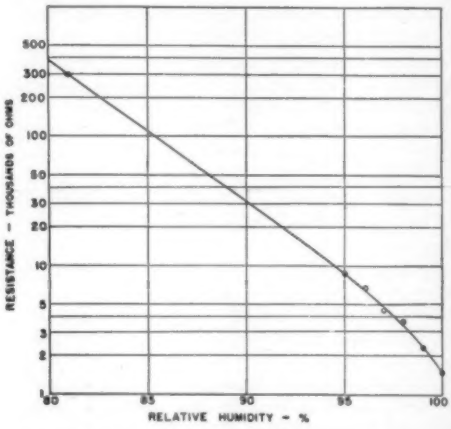

FIG. 1. Calibration curve of the humidity sensitive element.

In the process of producing a sensitive chemical film on the coil, a solution of the chemicals is first made. One part by weight of polyvinyl alcohol in powdered form is mixed with 3 parts ethyl alcohol, producing a viscous, cloudy solution. One part by volume of this solution is diluted with 6 parts of a solvent made with equal parts of water and ethyl alcohol. The still-cloudy solution is allowed to settle for a few days in a well-stoppered bottle. The top clear portion is then decanted, and to this is added 1% of a saturated solution of lithium chloride.

The sensitive film is formed by dipping the coil form into the above solution so that all the wires are covered, and slowly and steadily withdrawing the form, taking about 10 min to withdraw it completely. The element is then stored in a clean, dry place and allowed to "cure" for several days before being used. It was found that this element satisfactorily covered the range from 80% to 100% relative humidity, with a corresponding variation in resistance from 400,000 to 1,500 ohms.

The resistance of the element was measured on an a-c Wheatstone bridge. Alternating current must be

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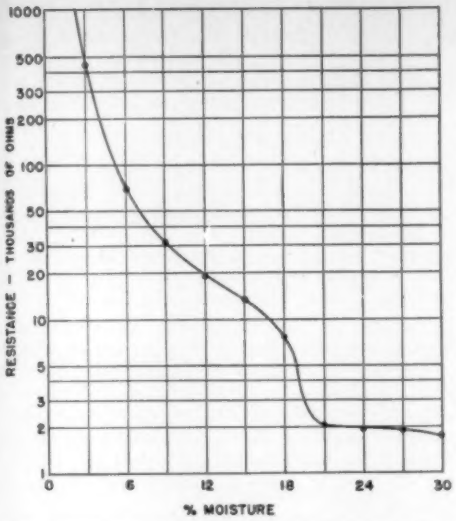

FIG. 2. Resistance of humidity sensitive element when located in an atmosphere in equilibrium with moist soil.

used since direct current would tend to polarize the chemicals, thus changing the properties of the film. The following procedure was adopted in taking readings. The element was stored in an enclosure maintained at 100% relative humidity. To take a reading the element was removed from the enclosure and allowed to dry in the air until its resistance was about 500,000 ohms. Such a resistance corresponds to a relative humidity of slightly less than 80% and so can easily be obtained in the open atmosphere. This drying process takes 2 or 3 min. The element is then put in the desired enclosure, and its resistance is read after a specified time interval. Five min is adequate, but the data herein presented were taken at 10 min.

In this manner the calibration curve shown in Fig. 1 was obtained. The sensitivity of the element is given by

$$S = (1/r)\,(\partial r/\partial H) = \partial \log r/\partial H,$$

where r is the resistance of the element and H is the relative humidity. The straight-line portion of the curve in Fig. 1 may be represented by

$$\log r = mH + \text{constant},$$

where m is the slope of the line. Upon differentiating this with respect to H, we find that the sensitivity is equal to m. Thus the sensitivity is a constant up to about 95% relative humidity. From 95% to 100% relative humidity the sensitivity increases approximately twofold.

The principal interest in this study was the indirect measurement of the free energy of soil moisture through the measurement of the soil atmosphere relative humidity. The possibility of measuring the free energy of soil moisture in this manner is based on the relationship between free energy of the soil moisture and the equilibrium relative humidity of the enclosed atmosphere:

$$H = 100e^{(f/RT)},$$

where H is the relative humidity in %, R the universal gas constant, T the absolute temperature, and f the free energy of the soil moisture ($f = 0$ for saturated soil, $f = -\infty$ for dry soil).

The desirability of measuring soil moisture in this way lies in the fact that the presence of soluble salts in no way interferes with the results. A curve of the element resistance as a function of percentage soil moisture is shown in Fig. 2 for a typical Hawaiian soil. It follows that the same method may be applied in other cases where it is desired to determine moisture content but where the usual conductivity method is unreliable because of the presence of soluble salts.

The increasing sensitivity is a desirable characteristic because the most important range in soil moisture work is between 98% and 100% relative humidity. For this reason an even greater sensitivity would be useful. This end might be achieved by a lower concentration of lithium chloride in the sensitive film, or even by the use of other salts. For achieving a more rapid equilibrium it is suggested that a construction be used in which the wires are supported intermittently rather than continuously, so that both sides of the film will be exposed to the atmosphere.

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The Inability of Thiourea to Modify Roentgen Ray Irradiation Mortality in Rats[1]

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Two recent reports (*1, 2*) showed that high doses of thiourea protected mice from the lethal effects of roentgen ray irradiation. The greatest protection was observed when the drug was administered by intraperitoneal injection immediately prior to irradiation. However, Limperos and Mosher (*1*) did show that oral premedication with 1% thiourea drinking water for 6 days prior to irradiation reduced the total mortality. As both the above reports dealt with dosages of thiourea that were within the toxic range, and because only mice were used, we decided to investigate the possible protection afforded rats who had received antithyroid but nontoxic doses of thiourea

[1] This article is based on work performed under Contract No. AT-04-1-GEN-12 between the Atomic Energy Commission and the University of California at Los Angeles.

TABLE 1

RESPONSE OF HYPOTHYROID, NORMAL, AND HYPERTHYROID RATS TO ROENTGEN RAY IRRADIATION

Group	Mortality ratio 30 days*	Appproximate LD_{50} day†	Percentage survival	Effect of medication on rate of mortality
Normal (control)	9/20	12.9	55	None
Thiourea	9/20	11.0	55	Increased
Thiourea and thyroxin	11/20	9.0	45	"
Thyroxin	9/20	11.8	55	"

* Mortality ratio = number dying/total number in group.
† LD_{50} day = day on which 25% of the animals were dead.

over a longer time interval prior to roentgen ray irradiation.

Male CFW rats weighing 140–179 g (average 155 g) were placed on Rockland rat diet and given 0.1% thiourea in drinking water for 37 days prior to irradiation. This was the time interval in which the animals reached a weight plateau. All animals were weighed weekly. They were arranged in groups of 20 as follows: Normal controls, thiourea controls, thiourea-irradiated, thyroxin controls, thyroxin-irradiated, thiourea-thyroxin controls and thiourea-thyroxin–irradiated. The thyroxin animals received 0.1 mg/animal/day Squibb thyroxin by intraperitoneal injection for 5 days before irradiation, and all of them showed the hyperexcitability and small weight loss usually observed after thyroxin medication. All animals in the irradiated groups were subjected to 600 r acute whole-body roentgen ray irradiation, administered with a 250 KVP Picker Industrial Unit calibrated before the experiment with a Victoreen Thimble r-meter. The technical factors were: 250 KVP; 15 ma; TSD 100 cm; filters: 0.21 mm Cu inherent, 0.5 mm Cu parabolic, and 1.0 mm Al; HVL 1.85 cm Cu; size of field, total; r/minute measured in air 9.9. Uniformity of dosage was assured by rotating the radiation cage during treatment. After irradiation the animals were maintained on their usual diet and received no further medication. Autopsies were performed upon all animals dying during the 39-day experimental period and upon all survivors at the end of that time. The usual signs of irradiation injury (diarrhea, bloody stools, petechial hemorrhages, pale mucous membranes, etc.) were observed in the irradiated groups. Gross examination of the thyroids in the animals medicated with thiourea alone showed the usual signs of antithyroid medication, whereas those that received thyroxin in addition to thiourea had normal appearing thyroids.

The average daily fluid intake per rat was 19 ml, equivalent to 19 mg thiourea. Table 1 indicates that ingestion of this amount of thiourea gave no protection. The slight increases in the rate of mortality seen with both the thiourea- and thyroxin-medicated groups were actually not significant. However, the increase in the mortality rate observed in those animals that had received both thyroxin and thiourea was significant. Inasmuch as none of the medicated nonirradiated control animals died during the experimental period, it appears that the lethal effects in the irradiated medicated groups were due to the irradiation received. However, there does appear to be a synergism between the irradiation and both the thiourea and the thyroxin insofar as the rate of mortality is concerned. Furthermore, it is quite evident that thiourea-induced hypothyroidism affords no protection against roentgen ray irradiation lethality.

Comparison of the results herein presented with those of Limperos and Mosher (*1*) and Mole *et al.* (*2*) indicates that the potential sulfhydryl group in the thiourea molecule is available, but a huge excess of thiourea must be present for protection against the lethal effects of roentgen ray irradiation. This would be in accord with the observations of Patt *et al.* (*3*) concerning glutathione and cysteine protection of irradiated animals. Further investigation of compounds containing potential sulfhydryl groups is now in the process of completion and will be reported in detail elsewhere.

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Should a "Law of Recency" Be Added to the International Code of Zoological Nomenclature?

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Proposal, counterproposal, and debate on zoological nomenclature have been presented in numerous zoological periodicals during recent years. Basically analyzed, the literature appears to represent a clash of opinion between two groups: those who feel that it is desirable to follow strictly Article 25 (the law of priority) and limit the commission's use of plenary powers, and those who advocate more extensive use of the plenary powers by the commission, with less strict application of Article 25.

Individuals in both groups admit that, at present, the procedures used are confusing and unwieldy. Each side concedes that there is some merit in the other's case. It is not the intention of the writers to enter into this debate; opinions of the two schools are perhaps irreconcilable in this generation.

The writers do feel, however, that constructive thought should be given by all zoologists to ways of preventing similar confusion in the future, especially by eliminating the words, too frequently found in the *Opinions* and the proposals in the *Bulletin of Zoological Nomenclature*, that such and such action "would clearly result in more confusion than uniformity." The debates being waged in all zoological literature

about the status of names clearly indicate that confusion is not entirely a matter of the future, but a real concern of the present.

An examination of the sources from which this confusion has arisen reveals that the important ones are:

1) Lack of knowledge of the existence of a publication;
2) Lack of knowledge of the exact date of publication;
3) The "dragging-out" of questions by different schools of thought arising from differences in interpretation of the Code and its applications;
4) Deliberate refusal to give up a name once it has been learned—i.e., deliberate failure to apply the law of priority and maintaining that its application will create "confusion."

Perhaps errors made in the past can be corrected only by rulings such as those being made by the commission under its plenary powers. But what about the future? Is the commission to continue to use its plenary powers indefinitely (or be forced to do so by allowing the same causes of confusion to continue to exist)? Is the commission to rule on its rulings as it apparently must do with the Meigen 1800 paper (*1*)?

It is evident that something is wrong when the commission has to use its plenary powers so often. There is a need for practical working procedure in nomenclature to avoid multiple use of names, especially at generic and suprageneric levels. The writers believe that if stability is ever to be obtained in the use of scientific names a "law of recency" must be added to complement the law of priority. Once a name is rejected it should not be used again as a valid name unless there are definite reasons for so doing and they are given in publication. The proposed "law of recency" might be stated as follows:

> The names used in the most recently published article dealing with the taxonomy or nomenclature of a group or species shall be regarded as authoritative *until further publication is made* reorganizing or otherwise disposing of the names involved and *giving the reasons why the changes are made.*

The need for such a law can be amply demonstrated. For instance, in 1915 Gahan (*2*) definitely synonymized many generic names with *Opius* Wesmael. In 1943 Hincks (*3*) wrote:

> *Bracon carbonarius* Nees, 1834, is designated as the genotype of *Opius* by Westwood (1840). This species is also the type of the monobasic genus *Biosteres* Foerster, 1862. For the present it will be better to transfer the whole of the species now grouped under *Biosteres* to the genus *Opius* until such time as an examination of the species leads to a regrouping. There are rather a large number of generic names available in this section, but it is evident that Gahan (1915) regards the divisions as of little generic value.

While Mr. Hincks' action appears to be correct, it illustrates the necessity of the proposed "law of recency," which would *compel* the transfer of the names in *Biosteres* to *Opius* and the acceptance of the synonymy given by Gahan until such time as the group was revised and *the reasons published* for changing the system used by Gahan.

The confusion that has existed with regard to *Bracon* Fabricius, *Cremnops* Foerster, and *Microbracon* Ashmead also illustrates the case in point. In 1917 Gahan (*4*) transferred the name *Bracon* to replace *Cremnops*. This name change was accepted in North America but rejected in Europe. Finally, in 1935, the question was decided by the International Commission, but the results were not published until 1943.

Although illustrations have been drawn from the family Braconidae, numerous other examples could be given—e.g., *Agrion* versus *Calopteryx* (*5*). Undoubtedly any taxonomist can readily cite similar cases in his particular field of interest.

At the present time, refusal to accept published synonymy is responsible for differences in accepted nomenclature between different groups or individuals. Such refusal and the resulting difference in accepted names mean that the cataloguer must constantly change species from one generic name to another and back as new articles appear—or carry the synonymy where he wishes, using his own interpretation in order to place the species in the "proper" place in his catalogue. The other alternative is to carry the species under several genera at the same time. In either case the situation produces much confusion and additional labor rather than stability.

Where does this leave the cataloguer? In the first illustration mentioned, is Gahan's synonymy to be accepted? Or are we free to ignore all but the original descriptions? Should the individual have the right to be "conservative," reject the published work of others (perhaps by merely ignoring it or dismissing it by stating that it is incorrect) and continue to use names that have been synonymized by others? For example, is Whiting's continued use of *Habrobracon juglandis* (Ashm.) valid?

The writers believe that the adoption of such a "law of recency" would aid in lessening the confusion created by sources (3) and (4), since points of disagreement would be brought to the fore where they could be acted upon by the International Commission when necessary, resulting in a much more rapid stabilization of names than occurs under the present system.

Incidentally, the lone expression "in the opinion of the writer" does not convey the extent of similarity or difference existing between organisms and perhaps should not be regarded as a valid reason for changing the established status of a name. The same objections may be raised against "new synonymy" or "new combination" when used without descriptions of similarities or differences.

To eliminate sources (1) and (2) it is suggested that names and their changes be considered as fully validated only after appearing in the *Zoological Record*, that for validation purposes the author be required to send a copy or facsimile reproduction of his publication to this source, giving the date on which the article in question was distributed (i.e., "published"), and that this date be included after the ref-

erence in the *Zoological Record* under the "Titles."

Such a procedure would eliminate the question of the date of publication serving as a source of future trouble. That the publication date is still a source of confusion is illustrated by the fact that Sabrosky (*6*) found it necessary to publish a note regarding the date of "publication" of an article distributed as late as 1948.

It also appears desirable to provide for continuing international support (perhaps through Unesco or some similar means) for the *Zoological Record* and to insure sufficient funds so that an adequate staff may be maintained to produce a new volume within the year following that with which the volume deals.

It would be the authors' suggestion that the plenary powers of the International Commission be terminated at the point where the names and dates are first validated in the *Zoological Record*; i.e., that the plenary powers not extend to names to be published in the future and that a date be set at which the application of the law of priority becomes rigid.

Since it is only through stabilization of the International Code and the procedures to be followed that nomenclature can be placed on a sound basis, the suggestions given are presented as a constructive criticism rather than from any derogatory motives. The authors would welcome both private communications and published discussions of the ideas herein submitted.

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Ultraviolet Absorption Spectra of Proteins

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Studies of the absorption spectra of proteins in the ultraviolet have led to the demonstration of bands associated with tyrosine, tryptophan, and phenylalanine (at about 280 mμ). In view of the results of the studies on fatty acids (*1, 2*), it seemed that in the region of 180–200 mμ a band might be present that would be representative of the peptide bonds. Through the courtesy of J. R. Platt we were able to confirm this conjecture by the finding that bovine serum albumin had a rather broad band with a maximum at about 190 mμ. To confirm that this band was also typical of simple peptides, glycylglycine and triglycine were also studied and gave the curves shown in Fig. 1. The complete quantitative data for bovine albumin are not available at this time, and this curve is not included, although a rapid analysis of the plates led to the above observation of a maximum.

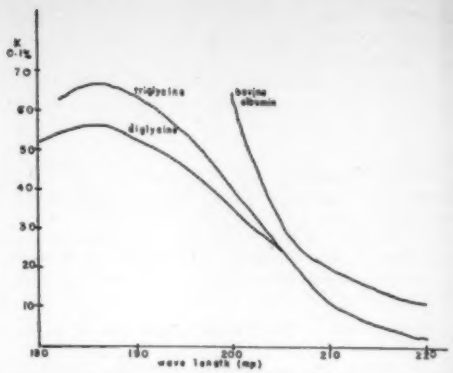

FIG. 1. Absorption spectra of bovine plasma albumin, diglycine, and triglycine.

A study of Ley and Arends' (*1*) data, as well as our own, on amino acids showed that near and above 205 mμ—i.e., on the shoulder of the curves—the absorptions of amino acids are of a much lower order of magnitude than the values for proteins and peptides. At lower wavelengths the absorption of the amino acids rises very rapidly, and near the maxima for peptides and bovine albumin amino acid absorption approximates, and is higher than, the absorption of peptide and protein. Since it is believed that the side chains of the constituent amino acids would make a definite contribution and corrections would be necessary, it was decided to obtain data for proteins for the region sufficiently high on the band and at the same time at wavelengths at which the amino acids absorb slightly. This region lies above 200 mμ.

The specific extinctions of several proteins and peptides were determined at 205 mμ. The specific extinction was multiplied by the molecular weights and divided by the number of peptide bonds (*3*). This gave a series of peptide extinctions (Table 1).

TABLE 1

PEPTIDE EXTINCTION FOR PROTEINS AND AMINO ACIDS

Compound	Peptide extinction (205 mμ)
Bovine albumin	2,580
Egg albumin	2,785
Gelatin	3,050
Glycylglycine	3,300
Triglycine	2,340

The agreement between the various proteins is fairly good, and all the values fall within the order of magnitude of each other. The values for the proteins are not considered rigidly assigned values for a peptide bond but rather as a statistically averaged value of the individual peptide bonds. This is confirmed by a series of studies (*4*) of simple di- and

tripeptides in which it was observed that the peptide absorption depends not only on the constituent amino acids but also on the order of arrangement. The variations, however, always remain within the order of magnitude of the values given above. It is concluded from these findings, as well as from studies on other proteins, that peptide bonds show a band with a maximum near 185 mμ and that data collected at 205 mμ mirror this band. The details of this study will be reported elsewhere.

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The Value of Small Lead Shields against the Injurious Effect of Total-Body Irradiation[1]

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Irradiation through small portals has long been recognized by radiologists to suppress hemopoiesis only slightly. Jacobson *et al.* (*1*), by a reverse approach, recently have shown that the lethal effects of total irradiation can be reduced by shielding the spleen alone. This report concerns the protection from lethal effects of whole-body irradiation afforded by lead shielding of other small body segments.

TABLE 1

Survival Rates

	Irradiation	No. rats	No. survivals	Percentage
Group I	None	20	20	100
Group II	Whole body	20	8	40
Group III	Liver shielded	12	10	83
Group IV	Right lung shielded	9	7	78
Group V	Right lower abdomen shielded	9	6	67

TABLE 2

Weights (in Grams)

	Area shielded	Before treatment	24 hr	48 hr	72 hr	10 days	20 days	30 days
Group I	Controls	197	196	197	196	203	208	204
Group II	No shield	214	212	203	197	194	198	215
Group III	Liver	204	203	202	200	208	206	206
Group IV	Right lung	200	199	199	198	197	203	198
Group V	Right lower abdomen	195	195	194	195	194	189	195

TABLE 3

Hemoglobin (g/100 ml)

	Area shielded	Before treatment	24 hr	48 hr	72 hr	10 days	20 days	30 days
Group I	Controls	14.3	14.0	14.4	13.9	14.0	14.4	14.7
Group II	None	14.7	14.2	13.8	13.5	11.7	12.8	14.4
Group III	Liver	13.9	14.3	13.9	13.7	12.4	12.5	14.0
Group IV	Right lung	13.7	13.9	14.5	14.1	13.3	13.1	13.2
Group V	Right lower abdomen	14.0	14.1	14.4	14.5	13.2	14.0	14.2

Young white rats weighing approximately 200 g were divided into five groups. Group I comprised 20 rats receiving no treatment. Group II comprised 20 rats which received 600 r total-body irradiation. In Group III were 12 rats exposed to 600 r total-body irradiation except over the liver, which was shielded by a lead plate ⅛ in. thick, measuring approximately 2.5 × 4.0 cm, put in place by fluoroscopic control. In Group IV were 9 rats treated like those in Group III except that the rectangular lead shield was placed over the right lung. In Group V were 9 rats, also treated like those in Group III except that the lead shield was placed over the right lower abdomen.

The rats were confined to close-fitting compartments in a wooden frame without anesthesia during irradiation. The x-ray factors were 200 kv; 25 ma; 50-cm distance; 0.5 mm Cu and 1.0 mm Al filter; HVL equivalent to 1.1 mm of Cu.

The survival time, the weights, and blood counts of all animals were recorded daily for the first 3 days, then every tenth day thereafter until the end of 30 days.

All the untreated animals in Group I survived, gained weight normally, and showed no disturbance in their blood counts.

The survival rates of all the partially shielded rats were higher than those exposed to whole-body irradiation. Of 20 rats in Group II which received whole-body irradiation, 8 survived. There were 10 survivals of the 12 rats protected over the liver in Group III, 7 survivals of 9 rats protected over the right lung in Group IV, and 6 survivals of 9 rats protected over the right lower abdomen in Group V. These results

[1] This investigation was supported by a grant from the Louis Sitnek Fund of the Eagleville Sanatorium, Eagleville, Pa.

TABLE 4

AVERAGE RED BLOOD CELL COUNTS (000 Omitted)

	Area shielded	Before treatment	24 hr	48 hr	72 hr	10 days	20 days	30 days
Group II	None	8,483	8,480	7,680	8,220	7,050	7,800	8,700
Group III	Liver	8,920	8,800	8,550	8,850	7,400	7,400	8,500
Group IV	Right lung	8,100	8,850	8,650	8,600	8,000	7,600	8,450
Group V	Right lower abdomen	8,714	8,714	9,150	8,750	8,100	8,500	8,500

TABLE 5

AVERAGE WHITE BLOOD CELL COUNTS

	Area shielded	Before treatment	24 hr	48 hr	72 hr	10 days	20 days	30 days
Group II	None	7,200	3,700	1,900	1,800	1,950	5,500	7,000
Group III	Liver	7,400	2,450	1,200	1,500	1,900	7,350	8,300
Group IV	Right lung	7,550	2,600	1,400	2,050	2,100	5,100	7,800
Group V	Right lower abdomen	7,150	1,950	1,100	1,450	2,050	6,500	5,700

would suggest that lead shielding of small areas of the body of rats increased the survival time appreciably above that resulting from total-body irradiation with no protection.

Although those shielded over the liver had slightly higher survival rates than those shielded over the right lung or right lower quadrant of the abdomen, the difference in survival rates between the partially shielded groups was not significant (Table 1). There was a slight loss of weight in all treated animals during the first week, but this weight loss was slightly more transient and less marked in the partially protected animals (Table 2).

Whole-body irradiation did not influence hemoglobin levels or red blood cell counts differently from the partially shielded animals. All groups showed a transient small drop in hemoglobin levels and red blood cell counts during the second and third weeks after exposure (Tables 3 and 4).

The white blood cell counts were depressed quickly within 24 hr in all irradiated animals and the counts were lowest during the first 2 weeks after exposure. Thereafter, a gradual improvement occurred, somewhat more rapidly in the partially shielded animals (Table 5). At the end of 4 weeks, the counts were normal again in all groups. The counts in Group V were slightly below normal, but not sufficient to be significant.

The polynuclear counts rose rapidly during the first 3 days in all irradiated animals, but by the tenth day a reversal was noted, when the counts were almost 50% below normal. Thereafter these counts rose to normal levels within 20–30 days, with not much difference among any groups (Table 6).

The lymphocyte counts were depressed rapidly during the first 3 days in all groups, and then this trend was reversed to slightly elevated positions by the tenth day. Thereafter, these counts slowly returned to normal levels (Table 7).

The lead shields used in the experiments covered approximately 15% of the body surface exposed to

TABLE 6

AVERAGE PERCENTAGES OF POLYNUCLEAR CELLS

	Area shielded	Before treatment	24 hr	48 hr	72 hr	10 days	20 days	30 days
Group II	None	40	75	74	66	32	15	42
Group III	Liver	44	62	66	80	23	29	40
Group IV	Right lung	47	63	76	68	26	45	30
Group V	Right lower abdomen	51	62	47	78	24	43	28

TABLE 7

AVERAGE PERCENTAGES OF LYMPHOCYTES

	Area shielded	Before treatment	24 hr	48 hr	72 hr	10 days	20 days	30 days
Group II	None	56	20	22	31	65	82	55
Group III	Liver	52	35	28	12	72	67	57
Group IV	Right lung	44	34	20	29	71	50	66
Group V	Right lower abdomen	42	34	48	18	68	49	68

irradiation, and shielded not only organs such as the liver, lung, and intestines, but also the surrounding bony structures, including portions of the spine. The results would indicate that lead shielding of small areas offers some protection against whole-body irradiation without much difference as to the location of the shielded areas. This suggests that it was the protection to the hemopoietic system rather than to organs such as the liver, intestines, or lung that resulted in the increased survival rate. It would seem also from these findings, that the liver, cecum, and lung do not have the same capacity as reported for the spleen (*1*) in sparing the rat from the lethal effects of irradiation.

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Plant Growth-stimulating Hormones in Immature Bean Seeds

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Immature seeds of plants such as apple, corn, rye, and wheat contain extractable phytohormones (*1–6*). Presence of these substances in seed extracts has been detected through their accelerating effect on the elongation of cells in oat coleoptiles and through their stimulating effect on the growth of tomato and pepper fruits. In studying these seed hormones, investigators have most often applied them to plants of different species from those from which they were taken.

In the present investigation, which was carried out under controlled greenhouse conditions, ether-soluble hormones obtained from the immature seeds of Black Valentine bean plants were applied to seedling plants of the same variety. Vegetative growth was accelerated in this way, and the plants were made to develop flowers 3–5 days earlier than untreated ones. The magnitude of the response reflected in vegetative growth varied, depending on the stage of development of the seeds from which the extracts were made.

Under the conditions of the experiment, the amount of ether-soluble hormones increased rapidly in the seeds after the fourth day following pollination, reaching a maximum on about the seventh or eighth day, and then decreased rapidly to an immeasurable amount on about the fifteenth day. The most potent extracts were obtained from seeds 3–4 mm long taken from pods that varied from 12 to 13 cm in length. Maximum rate of pod growth (increase in pod length) occurred during the first 8–10 days following pollination. Growth of the seeds (fresh weight) was most rapid subsequent to this period. The peak of extractable hormones was more closely associated with pod growth than with seed growth, but this does not mean that the hormones necessarily influenced growth of the pods (Fig. 1). The lack of extractable hormones in the case of relatively mature seeds was not due to the thickened seed coats, since these seeds, when chopped into small pieces and soaked in ether, failed to yield a measurable amount of hormones.

The extracts were prepared by soaking a freshly collected sample of whole seeds in moist ether at room temperature for 18–24 hr. After the ether was separated and evaporated, lanolin was mixed with the residue to afford the desired concentration of extract in the fatty carrier. In testing this method, the residue obtained from evaporating ether alone was mixed with lanolin and the mixture was applied to test plants, with no apparent effect.

In measuring the potency (cell-elongating activity) of an extract, lanolin paste containing a known amount of the extract was applied quantitatively and

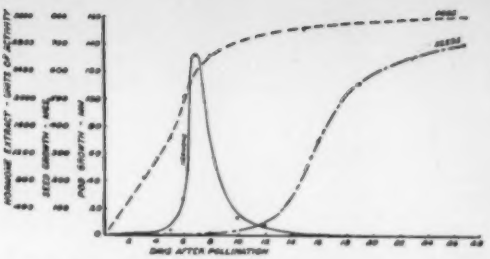

FIG. 1. Growth of bean pods and seeds in terms of length and fresh weight, respectively, compared with amount of extractable cell-elongating hormones obtained from the seeds at intervals following pollination.

unilaterally to the first internode of each seedling. The concentration of extract in the lanolin was varied during repeated trials, and the weight of extract required to cause a slight curvature of the stems was determined. Total activity of an extract was calculated by multiplying this value by the weight of extract obtained per seed. This method was used to measure the amount of extractable hormones in seeds at different stages of development (Fig. 1).

In some experiments, approximately 125 μg of the crude extract was applied in lanolin as a band around the first internodes of 10 seedlings. Ten comparable untreated plants were used for comparison. The extract stimulated elongation of the treated internodes and of all internodes above the treated ones, thus causing the stems to elongate much more rapidly than did those of the untreated plants (Table 1 and Fig. 2). The time of flowering was advanced 3–5 days, and the expansion of trifoliate leaves proceeded at a much more rapid rate on the treated than on the untreated plants. The extract affected stem growth much less when applied to relatively mature bean plants having several expanded trifoliate leaves than when applied to seedlings.

The extract stimulated growth of the seedlings when applied to the young succulent portions of their

TABLE 1

AVERAGE LENGTH (MM) OF INTERNODES OF BEAN PLANTS TREATED WITH 125 μG CRUDE SEED EXTRACT, COMPARED AT INTERVALS AFTER TREATMENT WITH AVERAGE LENGTH OF COMPARABLE INTERNODES OF UNTREATED PLANTS

Comparison	No. days					Internode
	2	5	6	7	8	
Check	39	52	53	54	54	First
Treated	89	115	116	117	117	
Check	0	10	19	28	32	Second
Treated	0	99	111	120	120	
Check	0	0	0	0	10	Third
Treated	0	5	32	74	95	
Check	0	0	0	0	0	Fourth
Treated	0	0	0	23	57	
Check	0	0	0	0	0	Fifth
Treated	0	0	0	0	10	

FIG. 2. Growth of bean plant (Black Valentine variety) following application of 125 μg hormone extract from immature seeds of other bean plants of the same variety, right. Comparable untreated plant, left. Photographed 3 weeks after treatment.

stems, but had no apparent effect when applied in equal amounts to the more mature part of their stems (hypocotyls) near the soil level. It failed to accelerate stem elongation of the seedlings when applied to either the upper or the lower surface of the primary leaves. Apparently hormones in the extract were not translocated from these leaves in sufficient amounts to bring about an observable effect in the stems.

Expansion of the primary leaves of seedlings was accelerated following application of the extract to a limited area on their upper or lower surfaces. Approximately 13 μg of the crude extract was applied in lanolin along the midribs of leaves, so as to cover an area of approximately 10 mm^2 on each leaf. The treated area was near the petiole attachment, in some instances on the ventral surface and in others on the dorsal surface. Elongation of the treated segment of midrib was accelerated. In addition, expansion of the treated leaves was increased so that their final area exceeded that of untreated ones by an average of 29.8% within a period of 6 days following treatment.

Untreated bean plants of the Black Valentine variety developed relatively short stems when grown under light supplied solely by means of daylight fluorescent tubes. In spite of the tendency to be short under these conditions, stems of seedlings treated with approximately 125 μg of the extract grew to be 3 times the height of untreated ones during the first 5 days of exposure to light from this source. Ten treated and 10 untreated plants were used in making the comparison, and the intensity of light used was 700–800 ft-c.

Since indolacetic acid accelerates cell elongation, the response of the plants to this compound was compared with that induced by means of the extract. Response to the extract was different in several respects from that which resulted from application of the acid. In comparing the responses, two series of treatments, comprised of 9 dosage levels of the acid and 9 of the extract, were prepared, with lanolin as a carrier. The dosages applied ranged from 125 to .013 μg/plant in each series. In treating, the paste was applied as a band around the first internode of each plant. Twenty-four hr after treatment, first internodes of plants treated with the optimum cell-elongating dose of the acid increased in length an average of 318% more than did those of untreated plants. During the same period, first internodes of seedlings treated with the most effective dose of seed extract increased in length an average of 870% more than did the untreated ones. Indolacetic acid brought about root initiation at the higher dosage levels, but the extract failed to cause this type of response at the highest dosage level used. The stimulating effect of the acid was confined to the treated first internode, whereas the extract not only accelerated elongation of this internode but also stimulated elongation of all internodes that developed above this segment of stem.

The extract had a systemic growth-stimulating effect when applied in minute amounts to the cotyledons of bean seeds that had just broken their coats in the process of germinating. Before the treatment was applied, the coats were removed from seeds that had developed radicles about 2.5 cm long. Approximately 13 μg of the extract was applied in lanolin as a thin layer covering about one fourth of the dorsal surface of each cotyledon. The treated seeds were replanted, along with an equal number of comparable but untreated ones from which the coats had also been removed.

Within 2½ days, growth of plants from treated seeds was noticeably more vigorous than that of the controls. This advantage persisted, and after 10 days the average lengths of the hypocotyls and first, second, and third internodes of plants that developed from the treated seeds were 10.9, 48.5, 65.8, and 100% greater, respectively, than the lengths of comparable

parts of plants from untreated seeds. The area of each leaf that developed during this period was increased by the seed treatment. Ten days after treatment, the plants from treated seeds had a total leaf area that was 27.6% greater than that of plants from untreated seeds.

Additional experiments are necessary to determine the effect of the seed extract on seed production of bean plants and to learn whether the growth of other crop plants, such as cereals, can be stimulated by phytohormones obtained from their seeds.

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Comments and Communications

Discriminatory Practices

One aspect of scientific life that seems to our department to require more general notice is that of eliminating discrimination against Negro scientists. Such discrimination occurs in many ways. Even when individual Negroes succeed in breaking through the barriers of economic, political, and academic discrimination sufficiently to acquire scientific training, they find employment opportunities severely restricted. In mathematics, at least, most qualified Negroes who find employment commensurate with their qualifications teach in Southern colleges. In attempting to participate in scientific life by way of the scientific societies, they become discouraged at the numerous restrictions placed on their participation and, in most instances, soon desist.

It is our view that the scientific societies, with their talk of the international character of science, must recognize its interracial character and put an end to discriminatory practices at meetings, etc. Accordingly, we have sent the attached letter to each member of the executive bodies of the two chief national mathematics organizations, and request you to publish it.

Lee Lorch

Department of Mathematics
Fisk University

Department of Mathematics,
Fisk University,
Nashville, Tennessee
April 20, 1951

Executive Council, American Mathematical Society
Board of Governors, Mathematical Association of America

Gentlemen:

The Fisk Mathematics Department hereby requests the American Mathematical Society and the Mathematical Association of America to insert into the respective by-laws of the two organizations explicit and effective protection of the rights of all members to participate fully, freely and equally in the affairs of the organizations without regard to race, creed or color. It should be stated flatly that meetings, and teas, receptions, luncheons, dinners, etc., associated with meetings, shall be held only at institutions, hotels, etc., where prior assurance is given that there will be no discrimination. In keeping with such a policy, it should also be voted that persons holding office shall not participate in any way in any meeting of the organization until they have been assured of full compliance with the letter and spirit of this bylaw, failure in this respect to be construed as resignation from office.

The adoption of such bylaws is necessary for the protection of the rights of members and of the mathematical community generally, as the episode related below will establish. It is also necessary for the growth of membership and participation among Negro mathematicians, nearly all of whom teach in Southern schools and who will need such specific assurances before they will feel inclined to participate in the work of these organizations. It would follow the lead of other professional societies which have already codified this basic policy, for example, the American Psychological Association (*Am. Psychol.*, 5, 548 [1950]).

One of the events which demonstrate the need for such official action occurred in connection with the annual meeting of the southeastern region of the Association, March 16–17, 1951, with Peabody and Vanderbilt as hosts. The official program of the meeting announced a dinner at which the national President of the Association would be the speaker. The chairman of the Fisk department requested four reservations in a note handed personally, on March 10, to the individual specified on the announcement. On March 15, the day before the banquet, the chairman of the arrangements committee telephoned Fisk to inquire if any of the four reservations would be used by Negroes. On receiving an affirmative reply, he declared the reservations cancelled, stating that the arrangements committee would issue no tickets to Negroes.

Two of the undersigned, acting for the department, then requested the national President to act against this discrimination. He spoke to the arrangements committee chairman and then reported that the latter was determined to exclude Negroes. Thereupon our committee requested the President to withdraw from the dinner in order to avoid giving the impression that the national officers sanction or tolerate such discrimination or, if unwilling to withdraw, to make his disapproval of discrimination clear in his speech at the dinner. He felt that he could not do either, holding the view that such acts would be discourteous to his hosts.

Some further clarifying remarks may be in order. There is no state law or city ordinance which prohibits interracial dinners. Of this we have been assured by local attorneys with long experience in such matters. There is substantial precedent for such dinners, which have been held even in some local hotels, which are frequent in some churches and other semiprivate dining halls and which are daily events at Fisk.

On November 6–7, 1950, Peabody and Vanderbilt were hosts to the Southern College Personnel Association. This organization's banquet was nonsegregated.

The point here is not that the hotel at which the Association held its banquet discriminates against Negroes. The point is that it was up to the arrangements committee to find a place, on the campus of one of the host institutions or elsewhere, where all mathematicians could participate.

Sincerely yours,

EVELYN BOYD
Associate Professor
WALTER BROWN
Assistant Professor
H. M. HOLLOWAY
Assistant Professor
LEE LORCH
Associate Professor and Chairman

Nuttall Memorial Celebration

THE year 1951 marks the end of the first half-century of systematic serology. In 1901 Nuttall first reported the results of testing precipitin antisera with a variety of antigens of animal origin, and with these reports and the researches that made them possible the science of comparative or systematic serology may be said to have been founded.

Appropriate observance of the half century of systematic serology is being made at Rutgers University's Serological Museum this year. On March 19 a Nuttall Memorial Celebration was held, with an exhibition of the work of the museum and of its Nuttall historical materials. The latter included some of Nuttall's original fluid sera, four of his charts, and two sets of protocols relating to the researches in blood relationship, all of which were given to the director of the Serological Museum during his visits to Cambridge in August 1950. Thanks and sincere appreciation are due to D. D. Keilin and Cambridge University for both the preservation and the gift of these historic materials.

The celebration was concluded with a symposium sponsored by the Rutgers Chapter of Sigma Xi, entitled "A Half-Century of Systematic Serology; the Work of Nuttall and his Associates at Cambridge and of his Successors in America." Those participating were: T. C. Nelson, whose account of Nuttall was based on his visits to Nuttall's laboratory and home in 1931; P. A. Moody, who reported on researches in systematic serology carried on under his direction; and Alan Boyden, who briefly summarized the more important work in the field and gave an appraisal of the significance of Nuttall's contributions to it:

> Nuttall himself was aware of some of the limitations of his techniques. In 1902, after completing a series of quantitative tests in which he measured the volumes of settled precipitates, he said, "I do not wish these numbers to be taken as final; nevertheless, they show the essential correctness of the previous crude results. To obtain a constant it will be necessary to make repeated tests with the bloods of each species and with different antiserums of one kind, making the tests with different proportions of antiserum. I am inclined to believe that with care we shall perhaps be able to measure species by this method, for it appears from the above results that there are measurable differences in the reactions obtained with related bloods, in other words, determinable degrees of blood relationship which we may be able to formulate."
>
> These words were prophetic—they pointed the way to future progress, and especially to the developments of the last decade. In spite of the obvious limitations of Nuttall's own techniques, he is unquestionably the founder of systematic serology and his contributions to the subject are many:
>
> 1) He was the first to have the insight to appreciate the potential significance of systematic serology and the enthusiasm to undertake an extensive study of its problems.
>
> 2) He inspired a small band of workers, Dinkelspiel, Graham-Smith, Strangeways, and Sanger, to join him in his studies of blood relationship and they worked effectively together in building the foundation for the future.
>
> 3) Nuttall and his associates did demonstrate a general parallelism between the systematic positions of animals, where they seemed to be relatively certain, and the precipitin tests of their sera. In fact, among the quantitative tests, only about 10% are obvious errors in view of modern knowledge in regard to the relationships of the species tested.
>
> 4) Nuttall and his associates provided evidences bearing upon the systematic positions of species or groups of doubtful relationship. Thus it was found that:
>
> *a*) Antilimulus serum reacted more strongly with arachnid sera than with decapod sera.
>
> *b*) The sera of whales were more similar to the sera of eventoes ungulates than to those of any other orders of Mammalia tested, (which we have recently confirmed).
>
> *c*) The serum and egg proteins of Aves show some evidences of similarity to those of Chelonia and Crocodilia.
>
> The greatness of a man does not depend alone upon his contribution of detailed fact to a subject; it also depends upon the kind of foundation he lays upon which others may build. Entirely aside from his great creative works in the field of parasitology and public health, we attest to his eminence in the field of systematic serology of which he was the founder. A half century of substantial progress has followed his lines of thought. And, as he considered his own work to be of a preliminary nature and looked to us to carry on, we, in turn, look to the future and to others with hope and confidence. Keen young men and women have been and are being prepared to continue the study of comparative serology. It will be both their pleasure and obligation to celebrate the Nuttall centenary at the appropriate time, and to recount the further developments which will then have been made manifest.

A fuller account of the celebration, including the reports of the principal speakers, together with other matters of significance relating to the half-century's developments in systematic serology, will be published in the *Bulletin of the Serological Museum*. Copies are available upon request.

ALAN BOYDEN
Serological Museum
Rutgers University

Book Reviews

Ecology of Animal Parasites. Jean G. Baer. Urbana: Univ. Illinois Press, 1951. 224 pp. $5.00.

This book, according to the author, is an attempt "to review the field of parasitology from all possible angles and to show that parasites are subjected to the same general laws that govern all free-living organisms." The aim is "to stimulate the reader's thoughts and to encourage him to consider old problems from new angles." The approach is refreshingly different and the author's aim has certainly been achieved. Baer is primarily a taxonomist, and one of the best. In addition he has a speculative and philosophical turn of mind that makes his writing definitely thought-provoking, whether or not one agrees with his deductions. "A taxonomic background," according to Baer, "is absolutely essential to a complete understanding of the relationships between the parasites and their hosts," but it is not *all* that is essential. The sections of the book that deal with morphological and biological adaptions are extremely interesting and valuable. Unfortunately, the same cannot be said for some of the other sections. It is evident that parasitology has expanded to such a degree that no one individual can hope successfully to "review the subject from all possible angles."

After a short chapter orienting parasitism in relation to phoresis, commensalism, and symbiosis, none of which is believed to lead to parasitism, a series of chapters is devoted to adaptations to parasitism in various groups of organisms. Many interesting forms that are not widely known among parasitologists are discussed. The relatively large amount of space devoted to Mollusca and to Crustacea is particularly welcome, since the literature on these forms is widely scattered. This section of the book contains numerous beautifully executed illustrations, but the diagrams showing composites of various life cycle modifications are difficult to follow. At the end of each phylogenetic section there is a short bibliography.

In a section on "Host-Parasite Relations," one chapter deals with host specificity, and another with action of parasites on hosts. As far as vertebrates are concerned the latter chapter deals mainly with immunology. Here the treatment is spotty and superficial. "Physiology of Parasites" is discussed, and there is a short final chapter on the origin of parasitism. The chapters dealing with physiology unfortunately contain a number of errors and misconceptions. For example, it is incorrectly stated that since respiration in *Litomosoides* is completely inhibited by cyanide there is no cytochrome present in this worm. In view of the fact that almost all that has been learned about endoenzymes in any organism has resulted from experiments on homogenized tissues, the statement that "mashing up worms to discover enzymes or to effect chemical analyses should be a thing of the past" will come as a surprise to biochemists and physiologists. Such statements as that *T. evansi* "contains very few enzymes" and that "the presence of enzymes in the tissues of tapeworms has been claimed by several authors but has never been proved in a satisfactory manner" suggest unfamiliarity with the numbers and roles of enzymes in all forms of life above the simpler viruses.

In spite of these limitations, this book contains so much interesting information, hitherto widely scattered in the literature, that it will be a welcome addition not only to every parasitologist's library, but also to the bookshelves of general biologists, who are likely to have their ideas of parasitology limited by the comparatively narrow medical and veterinary fields covered by most books on the subject.

Asa C. Chandler

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Photometric Atlas of the Near Infra-Red Solar Spectrum, λ8,465 to λ25,242. Orren C. Mohler *et al.* Ann Arbor: Univ. Michigan Press, 1950. 124 pp. $4.00.

This publication is the infrared counterpart of the *Utrecht Atlas* (Amsterdam, 1940), which covers the region up to λ8,771 A. It is the first work that contains continuous intensity tracings of high dispersion solar spectrograms in the near infrared region from 8,465 A to 25,242 A, a region of great interest to astrophysicists. The atlas represents a marvelous piece of work.

The intensity tracings given are reduced reproductions of the original records obtained at Mount Wilson Observatory with the Snow telescope and the infrared grating spectrometer constructed in the shop of the McMath-Hulbert Observatory of the University of Michigan. The grating has a ruled surface of 14½ cm × 18½ cm, with a total number of 74,000 lines. The resolving power averages about 30,000 but may be as high as 50,000 under favorable conditions. The recording system employs a lead-sulfide photoconductive cell, amplifier, and a Leeds & Northrup Speedomax recorder.

The atlas contains 324 partially overlapping tracings. In order to facilitate orientation and approximate wavelength measurements in general, three absorption lines are labeled with their wavelengths. The approximately linear dispersion, ranging from 3.7 mm/A at λ8,460 to 4.2 mm/A at λ25,000, allows simple linear interpolation.

The authors announce the preparation of a companion volume which will contain wavelength tables with identifications for solar and telluric lines of the atlas between 1.4 μ and 2.5 μ and data concerning equivalent widths.

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Trends in Gerontology. Nathan W. Shock. Stanford, Calif.: Stanford Univ. Press, 1951. 153 pp. $2.50.

After a brief introduction this excellent summary discusses population, employment, income maintenance, retirement, health, housing, education, community programs, research, and the creation of an institute of gerontology. It will prove very worthwhile reading for every thoughtful person. From it one can learn of the many diverse activities that effect healthful and satisfactory living during the later years of life. The book can help many individuals to create a sound plan for the inevitable future. The concluding chapter, stressing the need for one or more institutes of gerontology, indicates one of the greatest deficiencies in our current national research program. Very slow progress is being made in gerontological research, for most current programs are quite ephemeral.

A Classified Bibliography of Gerontology and Geriatrics. Nathan W. Shock. Stanford, Calif.: Stanford Univ. Press, 1951. 599 pp. $15.00.

This work, with 18,036 references, represents a landmark in the history of the study of aging. Although brief bibliographies have been published for several centuries in this field, they previously comprised reference lists attached to texts. The usefulness of this work will increase, as our civilization becomes more aware of the intricate problems of aging, because it affords rapid entrance into the literature of many specialized fields.

Both the author and subject indexes are quite complete. The list of journals cited is arranged alphabetically with the abbreviations used. The main headings include orientation, biology of aging, organ systems, geriatrics, psychological processes, social and economic aspects, and miscellaneous. The last section is probably the least complete but among the most interesting, for it covers such diverse topics as historical references, lay texts, nonliving systems, popular articles, research methods, organizations, programs, and institutes. During the years this work has been in progress the editor has become aware that bibliographies begin to age at conception; therefore the *Journal of Gerontology* plans to set up a fountain of youth by integrating its *Index to Current Periodical Literature* to accord with the classified outline of the *Classified Bibliography*.

Conference on Problems of Aging. Transactions of the Twelfth Conference, February 6–7, 1950, New York. Nathan W. Shock, Ed. New York: Josiah Macy, Jr. Foundation, 1951. 215 pp. $3.50.

The series of informal conferences recorded in this volume covers several divisions in the area of sociology and psychology. Under the titles of intrapersonal and interpersonal aspects, L. K. Frank and R. J. Havighurst presented brief reviews. These were followed by a discussion of the relation of gerontology to clinical medicine by E. J. Stieglitz and the psychopathological aspects of aging by W. Malamud.

Publication of these discussions permits the reader to take his place in the midst of a small group of diverse specialists. One observes the clinician matching ideas with the sociologist and psychologist as well as with the biologist. Much of the flavor of the original discussion is preserved. Lacking in such publications is the careful and often verbose development of bodies of information hung upon well-calcified skeletons.

The Macy Foundation publications would be much improved from the point of view of the collector if each carried a serial number following the plan of federal and state experiment stations.

C. M. McCay

New York State College of Agriculture
Cornell University

A History of Medicine: Primitive and Archaic Medicine, Vol. I, Henry E. Sigerist. New York: Oxford Univ. Press, 1951. 564 pp. $8.50.

The history of medicine is the history of mankind. At every stage in man's progress there has been the struggle against disease. Contractures and malformations resulting from infection as well as endocrine disturbances are clearly presented in the ancient ceramics and in the sketches traced by prehistoric man on the walls of caves.

In this, the first volume of a projected total of eight, the author relates his training for this most ambitious undertaking and gives a brief sketch of the entire work. Dr. Sigerist's linguistic ability and his broad experience in medicine are well known to his colleagues in the United States and Europe. His years as director of the Institute of the History of Medicine at Johns Hopkins brought him into active contact with many kindred spirits from all over the world. The foundation for this monumental work was thoroughly established in the classroom, in seminars, and in travel. He states his thesis as follows: "Medical history, therefore, will study health and disease through the ages, the conditions for health and disease and the history of all human activities that tended to promote health, to prevent illness, and to restore the sick, no matter who the acting individuals were."

The major part of the book is devoted to medicine in the great civilizations of the ancient Orient, Egypt, and Mesopotamia. The medical literature preserved in papyri and cuneiform tablets and other sources is described and analyzed. The closely related Papyrus Edwin Smith and Papyrus Ebers are considered in detail. At the end of each chapter there are extensive references, and reproductions of early works of art richly document the text. The author's scholarship and training for the task are clearly reflected. It is fervently hoped that he will be able to finish the task he has so valiantly undertaken.

Malcolm H. Soule

Ann Arbor, Michigan

News and Notes

Scientists in the News

Norman P. Auburn, vice president and dean of the University of Cincinnati, has been named president of the University of Akron. He succeeds **Hezzleton E. Simmons,** who, after 18 years in office, is retiring at age 65.

DeGaspe Beaubien, consulting engineer of Montreal; **A. N. Campbell,** professor of chemistry, University of Manitoba; and **Gordon G. Cushing,** secretary-treasurer, Trades and Labour Congress of Canada, Ottawa, have been made members of the National Research Council of Canada, succeeding Percy Bengough, P. E. Gagnon, and R. C. Wallace.

Myron Lee Bender, former Atomic Energy Commission post-doctoral fellow, has been named instructor in chemistry at Illinois Institute of Technology. During the past year he has been an instructor in chemistry at the University of Connecticut. **Allan H. Roush** has been appointed assistant professor in the Biology Department.

G. J. Bouyoucos, of Michigan State College, has been given an honorary doctor of science degree by the University of Thessalonike, Greece, for his many contributions to soil science and his services to Greece. He served on an agricultural mission to that country in 1917–19.

Clinton B. Burnett, vice president of the Johns-Manville Products Corporation, has been appointed engineering director of the Johns-Manville Corporation. He has been with the organization since 1931.

After 44 years with the Jewish Agricultural Society, **Gabriel Davidson** has retired as managing director. As consultant director he will handle the society's interests in Washington. He has been managing director since 1939.

As a lecturer in the program of Near East studies, **Bayard Dodge,** president of the American University of Beirut in Lebanon for 25 years, will join the Princeton University faculty. Dr. Dodge will offer a graduate course dealing with the political, economic, and social aspects of the contemporary Near East.

J. Franklin Ewing has been appointed director of the Institute of Contemporary Russian Studies at Fordham University. Father Ewing, who is assistant to Father McGinley for research, and assistant professor of anthropology at Fordham, will continue the duties of those posts. He succeeds **Richard T. Burgi,** first director of the institute and assistant professor of Russian literature at Yale.

Henry S. Frank has been made professor and head of the Department of Chemistry at the University of Pittsburgh, succeeding **Alexander Silverman** (*Science,* **114,** 24 [1951]), who has been associated with the university for nearly 45 years. From 1928 until this year, except for an interruption caused by World War II, Dr. Frank has been with Lingnan University, Canton, China, continuously as associate professor, professor of chemistry, chairman of the Chemistry Department, dean of the College of Science, vice provost, and provost. On his retirement Dr. Silverman donated his extensive collection of modern glass to New York State College of Ceramics.

J. J. Groot, instructor in the Department of Geography and Geology at the University of Delaware, has been appointed Delaware's first state geologist. Mr. Groot will direct the new Delaware Geological Survey created by an act of the recent General Assembly. Delaware is the last of the 48 states to acquire such a survey. The law requires that the university administer the survey under the general direction of a geological commission to be named by the governor. Appointment of the state geologist by the university's president also was provided by the law. The commission has not yet been selected.

Beno Gutenberg, director of the Seismological Laboratory at Caltech, has left for Paris for a meeting at Unesco headquarters. He plans to spend a month in Ankara advising the Turkish government on the installation of geophysical and seismological research centers. He will also go to Brussels to preside over a meeting of the International Committee on the Earth's Interior. He is scheduled to present a paper on the earth's core before the International Geophysical Union meeting in Brussels Aug. 22–Sept. 1.

The Community Service Society has announced that **Joseph McVicker Hunt,** director for the past five years of its Institute of Welfare Research, will become professor of psychology at the University of Illinois. He is president-elect of the American Psychological Association and was president of the New York State Psychological Association last year.

Allen S. Hussey has been appointed a senior chemist by the Carwin Company, North Haven, Conn. He has been assistant professor of organic chemistry at Northwestern University for the past four years. **Charles J. Smith, Jr.,** until recently product manager, the Lubrizol Corporation, Cleveland, has accepted a position as development manager with the Carwin Company.

G. W. Keitt, chairman of the Department of Plant Pathology of the University of Wisconsin, is a guest of the British Association for the Advancement of Science at its Edinburgh meeting. He will deliver before the Botany Section an invitation paper entitled "Inheritance of Pathogenicity and some other Characters in *Venturia inaequalis*." He was also a guest of the Association of Applied Biologists at its Con-

versazione at the Imperial College of Science and Technology, London, July 27, and a visitor at the Imperial College of Science and Technology, the universities of Cambridge and Bristol, Rothamsted Experimental Station, and the East Malling Research Station.

Recent visitors at the National Bureau of Standards include **Ataulla Khan,** Kabul Radio Station, Afghanistan, who is in the United States on a State Department grant, studying U. S. radio communication services; **T. Child,** British Engineers Small Tools and Equipment Co. Ltd., London; **Bjorn Ingleman,** A. B. Pharmacia, Stockholm; **W. A. Seeder,** Royal Verkade Factories, Inc., Zaandam; and **C. Timms,** National Physical Laboratories, Teddington, Eng.

Arthur J. Leedy, director of engineering, will manage a New Projects Department established by the Seiberling Rubber Company, Akron, Ohio. He will be assisted by **Alfred S. Bachtel** and **Henry A. Walter,** Production Department employees.

Carl C. Lindegren, director of Southern Illinois University's Biological Research Laboratory has returned from Bristol, Eng., where he spoke on "Yeast Genetics," in the Symposia of Experimental Biology.

Roy K. Marshall, who resigned March 1 as professor of astronomy and director of the Morehead Planetarium at the University of North Carolina, has been appointed educational director of the Philadelphia *Inquirer* Stations WFIL and WFIL-TV. Eight hours per week of educational programming, including the University of the Air, a cooperative operation by 19 colleges and universities in the Philadelphia area, will be continued under Dr. Marshall's direction next year.

Jules H. Masserman, associate professor of nervous and mental diseases at Northwestern University, and scientific director, National Foundation for Psychiatric Research, has been appointed consultant to the secretariat of the United Nations and designated by WHO to present a series of lectures at universities throughout Europe and Scandinavia in October and November of this year. During his stay in England, Dr. Masserman will also address the British Royal Society on his research.

Carl Alfred Moyer, professor of surgery and dean of the Southeastern Medical College in Dallas, has been appointed Bixby professor of surgery and head of the Department of Surgery at Washington University School of Medicine, succeeding **Evarts A. Graham,** who will become professor emeritus of surgery. Dr. Graham has been visiting in Glasgow, where he received an honorary degree during ceremonies celebrating the 500th anniversary of the University of Glasgow.

Sanborn Partridge, of Proctor, Vt., has been appointed assistant professor of geology at Amherst College, where, in addition to his teaching duties he will carry on research under the direction of George W. Bain, chairman of the Geology Department.

Roger R. Revelle has been named director of Scripps Institution of Oceanography at La Jolla. He has been acting director since March 1950, when **Carl Eckart** resigned the directorship to head the institution's Marine Physical Laboratory, at Point Loma.

Esther Loring Richards, after 34 years with the Phipps Clinic of Johns Hopkins Hospital, is retiring to devote her full time to private practice.

The University of Pennsylvania and the U. S. Naval Air Development Center at Johnsville, Bucks Co., have announced the appointment of **Robert F. Rushmer,** of the University of Washington, to be superintendent of the Scientific Department at the Navy's new Aviation Medical Acceleration Laboratory. The appointment of Dr. Rushmer is made in accordance with the terms of an agreement recently signed by Harold E. Stassen for the University of Pennsylvania and Selden B. Spangler, Commander of the NADC, whereby the university and the NADC have become affiliated. Dr. Rushmer has also been appointed professor of applied physiology on the faculty of the university's School of Medicine.

Louis L. Rusoff has been promoted from associate dairy nutritionist and associate professor to nutritionist and professor at Louisiana State University.

George H. Schneller, director of pharmaceutical application of the Calco Chemical Division, American Cyanamid Company, has been appointed chairman of the Research and Development Section of the American Drug Manufacturers Association. Dr. Schneller succeeds **A. Lee Caldwell,** of Eli Lilly and Company, who organized the section and was its chairman during the past three years.

The 1951 Charles H. McCrea Medal has been awarded by National Malleable and Steel Castings Company to **H. A. Schwartz,** who was named by the Malleable Founders' Society for his contribution toward progress and development in the malleable industry.

Loren B. Sjöström, head of the Flavor Laboratory at Arthur D. Little, Inc., has been elected chairman of the northeast section of the Institute of Food Technologists. Mr. Sjöström has been associated with Arthur D. Little since 1936.

Wesley W. Spink, University of Minnesota professor of medicine and brucellosis expert for the UN, is spending July and August in England, France, Italy, and Yugoslavia correlating current brucellosis research. Dr. Spink has been designated a consultant on the disease by WHO and FAO. He is director of the United States Brucellosis Center at the University of Minnesota.

John H. Van Vleck has become dean of applied sciences in the Harvard University Faculty of Arts and Sciences. **Albert Haertlein** has been appointed associate dean. Professor Van Vleck, a mathematical

physicist, is Hollis professor of mathematics and natural philosophy, and Professor Haertlein is Gordon McKay professor of civil engineering. Their administrative duties will be to carry out the development of applied science and engineering at Harvard in such fields as applied mathematics, physics, electronics, mechanical engineering, soil mechanics, and sanitary engineering. The new deans will carry forward a reorganization begun under Gordon M. Fair, who has served for the past two years as chairman of the Division of Engineering Sciences. Professor Fair will continue his teaching and research in sanitary engineering.

Alfred H. Weber has been named director of the Department of Physics, and **Haig Silvanie** director of the Department of Economics, at Saint Louis University. Dr. Weber has been secretary of the Department of Physics since 1939. He succeeds **James II Shannon**, who died last September after serving 37 years as director. Dr. Silvanie has been an associate professor of economics at Saint Louis since 1947. He succeeds **Bernard W. Dempsey**, who left to teach at the University of Delhi. Father Dempsey had been director of the department since 1943.

Douglas M. Whitaker is the new dean of Stanford's Faculty of Humanities and Sciences. Dr. Whitaker, who has been on leave of absence from the university to serve as chairman of the National Research Council, began his new duties July 1, succeeding **Clarence H. Faust**, who resigned in March to become president of the Fund for the Advancement of Education, established by the Ford Foundation (*Science*, **113**, 541 [1951]).

Philip R. White, formerly with the Institute for Cancer Research, Philadelphia, has joined the staff of the Roscoe B. Jackson Memorial Laboratory at Bar Harbor, Maine.

William R. Willard has been appointed dean of New York State University College of Medicine at Syracuse. Dr. Willard has been professor of public health and assistant dean in charge of postgraduate medical education at Yale University School of Medicine.

C. H. M. Williams and **D. Watt**, Faculty of Dentistry, University of Toronto, have been awarded first prize in the annual essay contest sponsored by the American Association of Orthodontists for the best original contribution to the science of orthodontics. Their work, under a grant from the Associate Committee on Dental Research, was on "Effects of Hard and Soft Diets on the Supporting Structures of Teeth."

Nathan A. Womack, of the University of Iowa, has accepted the position of professor and head of the Department of Surgery at the University of North Carolina School of Medicine, and will take up his duties in Chapel Hill late this summer. He was formerly professor of clinical surgery at Washington University.

Grants and Fellowships

The American Association of University Women is offering 25 fellowships, ranging from $1,000 to $3,000 for advanced study or research during 1952–53. For detailed information address the Secretary, Committee on Fellowship Awards, 1634 I St., N. W., Washington 6, D. C. Applications are returnable by *Dec. 15*.

American Pharmaceutical Manufacturer's Association has established two $2,500 graduate fellowships in pharmacy and in drug law. Richard E. Faust, of Greenfield, Mass., will continue his study in pharmaceutical chemistry and pharmacology at Purdue as a fellow of the American Foundation for Pharmaceutical Education, which will administer the fellowship. The law fellowship will be given to Charles L. Nelson, of Miami, Fla., who will study food and drug law at New York University's Food Law Institute.

The Wool Bureau has awarded the first **Anglo-American Fellowship** under its plan whereby selected Americans will study under leading scientists in England and on the Continent. Gerald Laxer, assistant development and research chemist in the Carpet Division of Alexander Smith, Inc., of Yonkers, will sail in September to take up studies under J. B. Speakman at Leeds University. The Wool Bureau expects eventually to support three fellowships in wool research.

Through the **Automotive Safety Foundation**, funds have been made available by the petroleum and automotive industries for a broad-gauge, two-year study by the Highway Research Board of the National Academy of Sciences, designed to diagnose the parking problem in American cities in relation to the economic health of communities, retail business, and motor-vehicle use. Regional university schools of business administration will begin the research this fall. A report will be published at the conclusion of the survey.

The **Clayton Foundation** has given $10,000 to the University of Texas Pharmaceutical Foundation to expand investigations of poisonous plants, particularly those found on the Texas plains. H. M. Burlage is directing the research, with Alfred Taylor of the Biochemical Institute.

The **Ford Foundation** has approved a grant of $1,309,500 to the Free University of Berlin. The funds will permit the establishment of an evening university for scientific education of working adults. Additional benefits will be a course of social studies, a special institute for European studies, and continuation of a program for U. S. educators to give courses in Berlin. The Free University, founded in 1948, now has a student body of 5,000 and employs a faculty of 250.

The **Health Information Foundation**, a nonprofit organization, has provided a grant of $92,000 for a two-year research project to be undertaken by Columbia University to find out what the 3 billion dollars spent in the U. S. each year for private medical and hospital care is used for. Oscar Serbein, Jr., of Colum-

bia Graduate School of Business, will attempt to assemble the facts on number of persons included in prepayment plans, illnesses covered, and medical services used. He will also explore the possibility of expanding and improving such plans.

A two-year experiment financed by the **James Foundation,** of St. James, Mo., to improve the general health services in that community is under way. Physicians in Phelps and Crawford counties will receive up to $500 each for postgraduate scholarships or refresher courses.

Harry A. Kuljian, Philadelphia engineer, has established two scholarships for MIT seniors in the School of Humanities and Social Studies, to help engineers meet the problems of human relations frequently encountered in their work, particularly in foreign countries.

The **Memphis Heart Association, Inc.,** has awarded the following grants at the University of Tennessee: to the Division of Surgery for research on hypertension; to R. V. Brown, associate professor of pharmacology, for work on blood pressure; to Robert C. Little, for investigation of stress; and to Lester Van Miccleworth, for investigation of the thyroid and adrenal gland hormones.

The **National Multiple Sclerosis Society** has awarded a sum of more than $15,000 to the H. L. Snyder Memorial Research Foundation, of Winfield, Kan., for a year of biochemical studies. Harold H. Jones will be director of research; he will be assisted by his son, Harold H. Jones, Jr., and Leitha D. Bunch, a multiple sclerotic.

In the Laboratories

Carpenter Steel Co., of Reading, Pa., has appointed George V. Luerssen vice president in charge of metallurgy, succeeding B. H. DeLong, who has retired after 41 years of service with the company. Carl B. Post will succeed Dr. Luerssen as chief metallurgist, and George E. Brumbach will succeed Dr. Post.

Joe D. Clary, of Chemical Products Corp., Cartersville, Ga., has been named superintendent of the specialty catalyst plant of the **Davison Chemical Corporation** at Curtis Bay, Md. Other new appointments in the Research and Development Division are: Albert H. Cooper, as head of the Research Engineering Department; Walter K. O'Loughlin, as manager of the Development Department; and Kenneth E. Prince, as head of the Patent Department.

With the retirement of Elmer K. Bolton as director of the **Dupont Chemical Department** (*Science,* **114,** 51 [1951]), Paul L. Salzberg has been named assistant director, David M. McQueen succeeding him as laboratory director at the Experimental Station. Burt C. Pratt will become assistant laboratory director, and Clement W. Theobald research supervisor.

Gesell Institute of Child Development has recently been set up to carry on the work begun at the Yale Clinic of Child Development under Arnold Gesell. Francis L. Ilg is acting director, and Dr. Gesell research consultant.

Julius Hyman and Company, of Denver, opened a new plant pathological laboratory and greenhouse in June. The laboratory, under the direction of J. A. Pinckard, works in close cooperation with the Colorado Agricultural Experiment Station and with other state experimental stations in the screening of new compounds synthesized in its Department of Organic Chemistry.

The **Institute of Living,** Hartford, Conn., has appointed Francis J. Braceland as psychiatrist-in-chief to succeed C. C. Burlingame, who died last year.

The **Jewish Medical Center** now under construction in Baltimore has received a gift of $1,000,000 for an obstetrical and gynecological building in the Sinai Hospital unit. The gift was made by Henrietta Blaustein in memory of her husband. The building will be known as the Louis and Henrietta Blaustein Building.

Los Alamos Scientific Laboratory has announced the addition of these scientists to its staff: Irving R. Tannenbaum, chemist, and John R. Beyster, James Terrell, Jr., and Max Carl Walske, Jr., physicists.

The **Pemco Corporation** (ceramic products) has been presented with the 1951 Merit Award of the American Society of Industrial Engineers for "excellence in engineering and manufacturing." It was the first industrial firm in the state of Maryland to receive such an award.

Wallace L. Davidson has been appointed industrial physician for the Glenolden and West Point, Pa., plants of **Sharp & Dohme, Inc.** A graduate in medicine of the Hahnemann Medical College, Dr. Davidson worked in private practice until his present association with Sharp & Dohme.

Tracerlab, Inc., will have the help of a new Research Advisory Board consisting of Karl T. Compton, chairman; Lewis L. Strauss, Charles D. Coryell, and Wendell C. Peacock. A nine-member employee group, to be known as the Auxiliary Board of Management, has also been appointed.

Verne C. Bidlack, Jr., has joined the Research Department of **Henry K. Wampole & Co., Inc.,** of Philadelphia.

The **Upjohn Company** has placed in full operation a new pharmaceutical plant just outside Kalamazoo, Mich., thus increasing its production facilities by 50%. The plant has been designed to leave space and facilities available for the large-scale production of drugs still to be discovered and developed. To mark the opening of the new plant, the Upjohn Company has published *The Odyssey of Modern Drug Research,* a 124-page illustrated booklet by Robert Burlingham.

Meetings and Elections

The twentieth anniversary of the **American Institute of Physics** will be celebrated at the Hotel Sherman, Chicago, October 23–27, by a joint meeting of the founding societies of the institute. Member societies that will hold their regular fall technical meetings during the celebration are the American Physical Society (Oct. 25–27); the Optical Society of America (Oct. 23–25); the Acoustical Society of America (Oct. 23–25); the Society of Rheology (Oct. 24–26); and the American Association of Physics Teachers (Oct. 25–27). The American Crystallographic Association, an affiliated society, will also participate in the meeting. Several hundred papers on original research will be presented. A symposium on the theme "Physics Today" will feature papers on nuclear, atomic, and solid state physics, acoustics, and optics, by Enrico Fermi, E. U. Condon, J. C. Slater, Harvey Fletcher, and Edwin H. Land. The symposium will be concluded with a more general talk entitled "Physics as Science and as Art," by K. K. Darrow.

At the annual meeting of the **American Psychiatric Association** in Cincinnati, D. Ewen Cameron became president-elect; R. Finley Gayle, Jr., secretary; Howard W. Potter, treasurer; and J. Fremont Bateman, Frank J. Curran, and William B. Terhune, councillors. L. H. Bartemier is incoming president.

The **American Society of Mammalogists** elected the following officers at its annual meeting in June, held at the Chicago Natural History Museum: president, William J. Hamilton, Jr.; vice presidents, William H. Burt and William B. Davis; recording secretary, Robert T. Orr; corresponding secretary, Donald F. Hossmeister; treasurer, Viola S. Schants; editor, William H. Burt. New directors are: Victor H. Cahalane, Emmet T. Hooper, J. Kenneth Doutt, W. Robert Eadie, Antoon De Vos, and Stanley P. Young.

The annual Meeting of the **American Society of X-Ray Technicians** was held in June in Philadelphia. New officers are Alexander Turner, president; Hazel Cole, Ruth Jaffke, and M. Salvatore, vice presidents; and Mary Knish, secretary-treasurer.

Samuel G. Hibben will take office as president of the **Illuminating Engineering Society** on October 1. Other newly elected officers are: vice president, A. H. Manwaring; treasurer, R. F. Hartenstein; general secretary, C. C. Keller; directors, G. W. Beals and J. S. Schuchert.

An **International Symposium on the Chemistry of ACTH** will be sponsored by Armour and Company in Chicago on Sept. 18, following the jubilee meeting of the American Chemical Society. Formal papers will be presented by David F. Waugh, E. B. Astwood, Emil M. Smith, George W. Sayers, Sidney W. Fox, Wendell M. Stanley, C. H. Li, J. I. Harris, Fred W. Carpenter, Wilfred White, and Joseph D. Fisher. Among foreign visitors expected are Arne Tiselius, A. R. Todd, and C. J. O'R. Morris.

The Board of Medical Consultants of the Oak Ridge Institute of Nuclear Studies will in the future be known as the **Medical Advisory Panel.** George T. Harrell, Jr., chairman of the Department of Internal Medicine at Bowman Gray School of Medicine, was elected chairman of the panel at a meeting last June, succeeding Wilburt C. Davison, of Duke Medical School.

The **National Conference on Research in English** has elected these officers for the year 1951–52: president, John J. DeBoer; vice president, Roy I. Johnson; and secretary-treasurer, Gertrude Whipple.

At the annual congress of the **South African Association for the Advancement of Science,** held at Durban, Basil F. Schonland, F. R. S., was elected to succeed E. G. Malherbe as president. Dr. Schonland is professor of geophysics at the University of the Witwatersrand and was first director of the Council for Scientific and Industrial Research.

Miscellaneous

New Washington addresses are, for the **American Psychiatric Association,** 1785 Massachusetts Ave., N.W., and, for the **Pan American Sanitary Bureau,** 1501 New Hampshire Ave., N.W.

Volume II of the fourth edition of the ***Bibliography of References to the Literature on the Minor Elements and their Relation to Plant and Animal Nutrition*** has been published by the Chilean Nitrate Educational Bureau. Volume II contains 1,222 abstracts covering July 1947–December 1950, and includes 141 crops, 45 elements, and about 1,300 authors, with complete indices.

Among new journals recently received is ***Bulletin of Marine Science of the Gulf and Caribbean,*** published by the Marine Laboratory of the University of Miami. Robert H. Williams is editor. ***Educational Theory,*** a new quarterly journal, will be published by the John Dewey Society of the University of Illinois College of Education, with Archibald W. Anderson as editor. ***Ingenieria Química e Industrias,*** the official organ of the Instituto Peruano de Ingenieros Químicos, Lima, of which Germán de La Fuente H. is president, is in Spanish. International Universities Press is publishing the quarterly ***International Journal of Group Psychotherapy*** for the American Group Psychotherapy Association. ***The Irish Astronomical Journal*** is a new quarterly nontechnical review, of the Irish Astronomical Society. The ***Pacific Journal of Mathematics,*** a quarterly, is being sponsored by a number of West Coast universities, including the University of British Columbia. It will be devoted to basic research articles and will be offered to individual faculty members of the sponsoring institutions and to members of the American Mathematical Society, which is furnishing financial aid.

Chemicals wanted by the registry of rare chemicals, 35 W. 33rd St., Chicago 16, Ill., include: rhenium

oxide; triphenyl borate; *n*-octyl diphenyl phosphate; γ-ferric oxide; dibutyl phosphine; 2-pentadecanone; 15-nonacosanol; nitrosomethylurethane; α-mercaptobutyric acid; tetraphenyl hydrazine; tripenylmethyl mercaptan; indene; *n*-octyl benzene; diphenyl malonic acid; 2-ethyl anthraquinone; guanase; adenase; pulegol; adenosine deaminase; and rennin.

Child-Family Digest has been taken over by The Lieutenant Gayle Aiken III Memorial Foundation as a means of promoting emotional health and total well-being. Advisory editors are Grace Bain, M. Bevan-Brown, Gladys Hasty Carroll, Enid F. Cook, Wilburt C. Davison, Miner Clifford Hill, Ernest Harms, Weston La Barre, James Clark Molony, Mary Palmer, Grantly Dick Read, Jarl Wagner Smitt, Wm. Perrin Nicolson, Wm. R. Strange, and Albert M. Vollmer.

The **Charles A. Coffin** award, established 29 years ago by privately owned electric utilities, went in 1950 to Georgia Power Company for its "great contributions to the progress and well-being of the state of Georgia." The award consists of a gold medal and $1,000 for the employees' benefit fund of the winning company.

Among missions recently sponsored by the **Economic Cooperation Administration** was the visit of a group of French paint manufacturers to New York, Newark, Philadelphia, Cleveland, and Detroit. Seventeen men representing a Paper and Board Packaging Mission from several European countries have been gathering technical information in the U. S., and fourteen members of a Netherlands Enamelware Productivity Group toured the U. S. studying production methods and equipment in the industry.

The **Institute of Medicine of Chicago** offers the Joseph A. Capps prize, founded by Dr. and Mrs. Edwin R. LeCount, for the most meritorious investigation in medicine or in the specialties of medicine. The investigation may also be in the fundamental sciences, provided the work has a definite bearing on some medical problem. Competition for 1951 is open to graduates of Chicago medical schools who completed their internship or one year of laboratory work in 1949 or thereafter. Manuscripts must be submitted to the Secretary, 86 E. Randolph St., Chicago 1, not later than *Dec. 31.*

George G. Jackson, of Boston, has been appointed assistant professor of preventive medicine at the University of Illinois College of Medicine. He has been holding joint appointments as Milton fellow in medicine at Harvard, research fellow at Thorndike Memorial Laboratory, and assistant in medicine at Boston City Hospital.

The **National Association of Science Writers** and the **New York University Department of Journalism** survey recently completed, on the attitude of managing editors of newspapers toward science writing, reveals that the amount of space given to science news has doubled during the past ten years in newspapers of all classes. Predominant interest, as always, is in the fields of medicine and public health, with atomic energy and agriculture following close behind. Physics and chemistry are at the bottom of the list, so far as editors are concerned. Limitations of space, as well as lack of suitable copy, prevent the use of more items, editors declared.

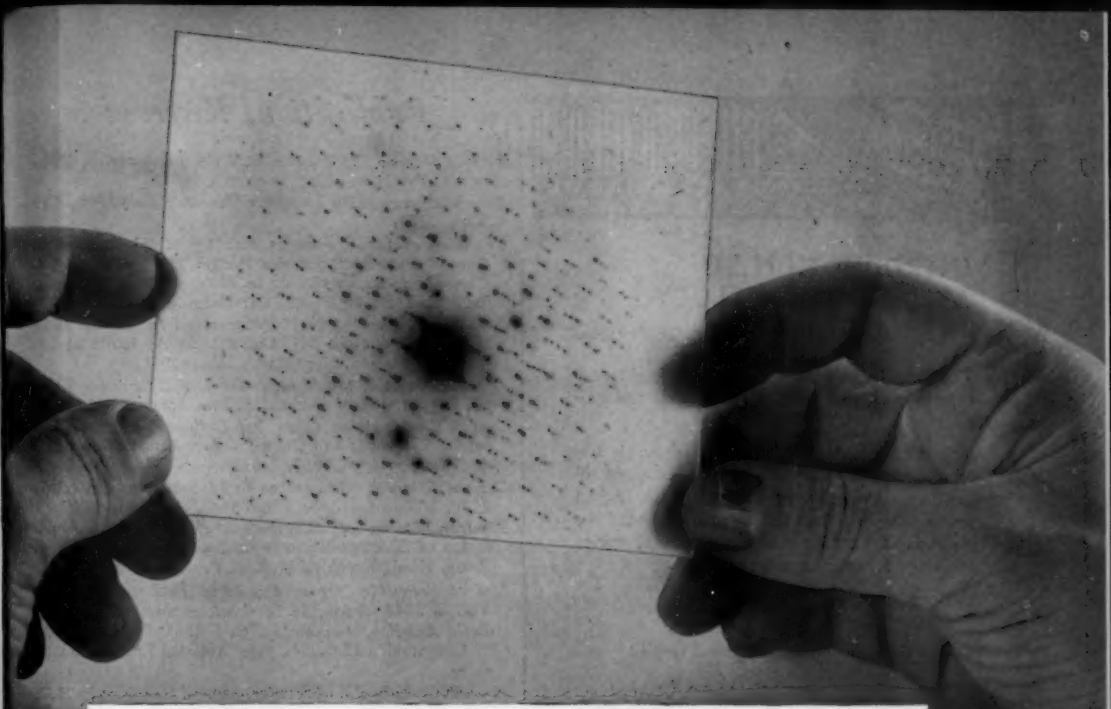
The **New York Adult Education Council,** 254 Fourth Ave., New York, is planning a three-year study to determine how people approaching retirement age "can be helped to make good and realistic preparation" for the years following retirement. The council is seeking contributions amounting to a total of $100,000 to pursue the project, which is under the direction of Alonzo F. Myers, chairman of the Department of Higher Education at New York University. One hundred men and women in the New York metropolitan area will be selected as volunteer subjects.

European visitors in the U. S. during the fall months will include **Edgar Salin,** professor of political economy at the University of Basel, and **Dolf Sternberger;** of the Department of Social and Political Science, University of Heidelberg. Both will lecture under the sponsorship of the Institute of International Education.

Research positions will be available to applicants with a degree in petroleum engineering with the **Texas Petroleum Research Committee** in the secondary recovery of petroleum. Laboratories are at A. & M. College of Texas and the University of Texas, where work has already begun. Apply at once to George Fancher, director of the committee, University of Texas, Austin 12, for work beginning *Sept. 1.*

The College of Physicians of Philadelphia has awarded the Alvarenga Prize for 1951 to **George W. Thorn,** Hersey professor of the theory and practice of physic, Harvard University Medical School, for his outstanding contributions to our knowledge of the role of the adrenal cortex in health and disease. The prize was established by the will of Pedro Francisco DaCosta Alvarenga of Lisbon, an associate fellow of the College of Physicians of Philadelphia, to be awarded annually.

In the death of **Malcolm H. Soule** on Aug. 3, the AAAS has lost one of its staunchest supporters and most ardent and conscientious workers. Vice president of the Section on Medicine and member of the Executive Committee and the Council, he was active also as a member of the Editorial Board and as chairman of the committees on Affiliation and Association, and on the Theobald Smith Award. For many years he effectively guided the affairs of Section N as section secretary and helped formulate the publication policies of the Association. His death can arouse only feelings of deepest regret and sorrow among members of the Executive Committee, the Council, the Editorial Board, and the membership as a whole.



The electrons landed here...

. . . and the diffraction pattern they left on this plate measures the splitting of the laminae in a 1000-Angstrom-unit-thick sheet of bent mica through which they passed.

For industry, electron diffraction patterns are revealing and identifying oxides on non-ferrous metals, the faint beginnings of corrosion on steel, scale in distillation equipment, crystal formations in chemical processes—thin films of all kinds.

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Publications Received

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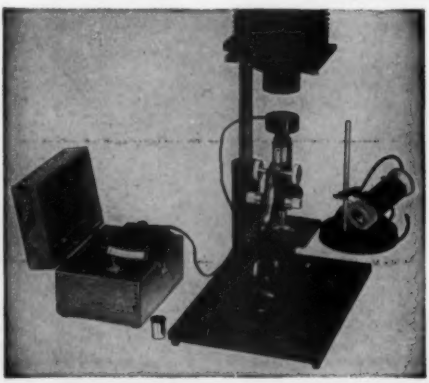

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Aug. 26–31. American Pharmaceutical Association. Statler Hotel, Buffalo.
Aug. 27–30. Illuminating Engineering Society. Washington, D. C.
Aug. 27–31. American Society of Agronomy. Pennsylvania State College, State College.
Aug. 27–31. Soil Science Society of America. Pennsylvania State College, State College.
Aug. 31–Sept. 5. American Psychological Association. Hotel Sherman, Chicago.
Sept. 3–4. Mathematical Association of America (Summer). University of Minnesota, Minneapolis.
Sept. 3–7. American Chemical Society (Annual). New York.
Sept. 4–8. Second Alaskan Science Conference. Alaska Division, AAAS, and University of Alaska. Mt. McKinley National Park.
Sept. 4–9. British and Austrian Iron and Steel Institutes (joint meeting). Salzburg.
Sept. 5–7. Mycological Society of America. University of Minnesota, Minneapolis.
Sept. 3–9. International Union of Pure and Applied Chemistry. New York.
Sept. 8–12. Ecological Society of America. University of Minnesota, Minneapolis.
Sept. 9–14. International Gerontological Congress. Hotel Jefferson, St. Louis.
Sept. 10–12. American Institute of Biological Sciences (Annual). University of Minnesota, Minneapolis.
Sept. 10–13. International Congress of Pure and Applied Chemistry. New York.
Sept. 10–14. Instrument Society of America. Sam Houston Coliseum, Houston, Tex.
Sept. 12–14. American Fisheries Society (Annual). Rochester, New York.
Sept. 12–14. Biological Photographic Association (Annual). Kenmore Hotel, Boston.
Sept. 12–14. National Petroleum Association. Hotel Traymore, Atlantic City.
Sept. 13. World Metallurgical Congress. Detroit, Mich.
Sept. 13–15. American Society of Limnology and Oceanography (Annual). Rochester, New York.
Sept. 14–15. International Union of Pure and Applied Chemistry. Washington, D. C.
Sept. 14–16. Applied International Spectroscopy Colloquium. Venice.
Sept. 14–16. International Federation for Documentation. Rome.
Sept. 15–21. World Medical Association. Stockholm.
Sept. 16–19. American Institute of Chemical Engineers (Regional). French Lick, Ind.
Sept. 16–19. American Institute of Chemical Engineers (Regional). Sheraton Hotel, Rochester, N. Y.
Sept. 16–22. Association of German Physical Societies. Karlsruhe.
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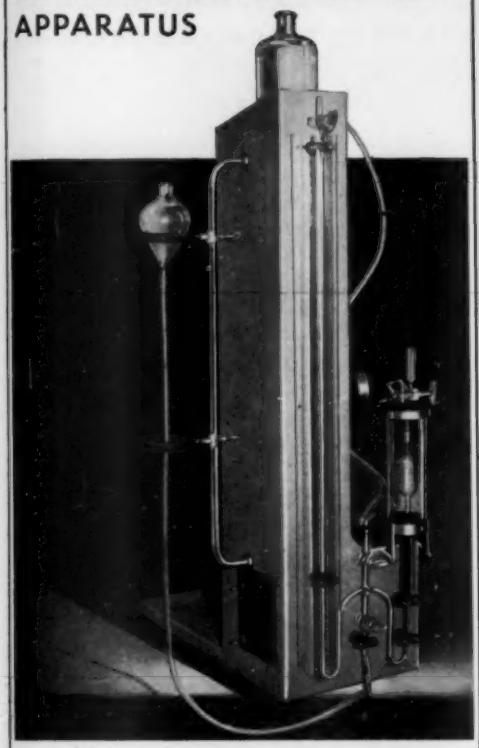

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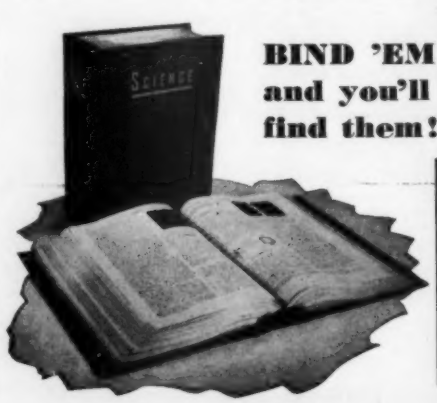

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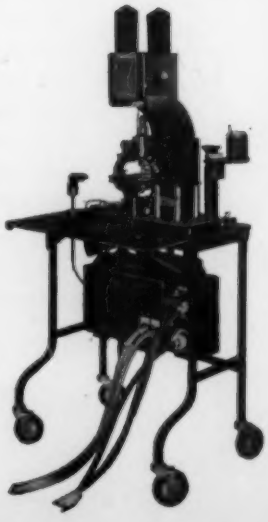

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PRICE IS $147.00

for Phase Turret Condenser with Centering Telescope, in case. Objectives and annular diaphragms extra, as selected.

It's a simple, economical matter for owners of AO Spencer No. 33 or 13 Microscopes to convert for *Phase Microscopy*. Just add the AO Spencer Phase Turret Condenser and your selection of phase objectives with corresponding annular diaphragms.

You may choose from 10X, 20X, 43X, and 97X phase objectives in Bright Contrast, Dark Contrast, or B-Minus Contrast. Annular diaphragms are interchangeable and individually centerable. The Turret operates easily and without backlash. Centerable condenser mount permits accurate location of the condenser in the substage.

Special long focus Diaphragms are available for micro manipulation and tissue cultures located up to 17 mm above the stage.

A limited supply of these AO Phase Turret Condensers is available for immediate delivery.

See your AO Spencer Distributor or write Dept. V2.

American Optical COMPANY

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